ENGINEERING NEWS

THE STEAM CAR-HEATING LAW goes into effect in New York State on Nov. 1. By an amendment passed last winter, the State Railroad Commissioners are empowered to grant extension to certain parties on good reason, and a hearing has been given to the following roads:—The Delaware & Hudson asked to be relieved for two months; this company has adopted the MCELROY system, but the cars cannot be equipped by November. The Grand Trunk R. R. wanted exemption for one year, so that it might obtain the best system. The Lehigh, Pennsylvania, and Lackawanna railroad companies asked for a year's relief because no uniform coupler or steam heating device had been adopted; several lines ran over the Lehigh road and the trains were made up of mixed cars. The Commissioners reserved their decision. As one of the chief obstructions in the way of adopting steam car-heating devices was the lack of a uniform steam coupler, the State Railroad Commission issued later the following notice to railroad companies operating in New York State:

Your attention is drawn to Chapter 189 of the Laws of 1888, entitled "An Act to amend Chapter 616 of the Laws of 1887, entitled "An Act to regulate the heating of steam passenger cars and to provide for the placing of guards and guard posts on railroad bridges and trestles and the approaches thereto." This law goes into effect on Nov. 1, 1888.

Inasmuch as one of the principal obstacles in the way of conforming to this statute appears to be the failure upon the part of the railroad corporations thus far to agree upon a uniform steam coupler, the Board hereby notifies you that a public hearing will be held at its office in Albany, at 10 o'clock A. M., on Tuesday, October 16, at which time you are requested to send a representative of your road with authority to agree upon some form of uniform steam coupler with other representatives of railroads of the State.

The Board furthermore urges upon you the necessity, in the meantime, of taking such action as will lead to the adoption of a uniform steam coupler and thus overcome the difficulties in the way of conforming to the law hereinbefore quoted.

THE Obi Railway, now under construction on the Southern border of Central Siberia, will be 260 miles long; and extends from Obdorskoe, near the source of the Obi river, to the Kara Sea, which is navigable for some months in the year. A canal is also building to connect the Obi with the Yenisei.

THE READING RAILROAD TERMINAL CONTROVERSY in Philadelphia is now before a Board of Trade Committee called to harmonize the opposing interests, if possible. Mr. E R. WOOD, the Chairman of this Committee, put the whole thing in a nut-shell when he said that the parties to be harmonized were not so much the city and railroad company, as it was the latter and the powerful Traction Company, which has a grip on Philadelphia street traffic on a line parallel to the proposed Reading extension.

THE Brooklyn Bridge Trustees, at a late meeting, reported an increase of business over September 1887 of nearly $4,000. The total receipts were $76,831.72, of which $69,303.52 came from the railroad, $5,870.25 from the carriage-way and $1,657.95 from the footways. The total of passengers last month was 2,777,424, of which number only 265,400 walked.

THE Wheeling & Harrisburg R. R. bridge over the Ohio river at Wheeling, W. Va., was commenced on Oct. 9. This is a union railroad bridge to connect all the roads centering at that point. The bridge will be 2,100 ft. long and double track. GUSTAV LINDENTHAL, of Pittsburg, is the engineer. This terminal scheme also includes a tunnel 1,600 ft. long and another bridge over Wheeling creek, involving the expenditure of several millions of dollars.

THE Cincinnati, Hamilton & Dayton company is said to be placing under the coaches and baggage cars which are run in its fast trains a truck which is about one-third heavier than the ordinary truck, and has paper wheels. This improvement is to go on as fast as the coaches can be brought into the shop, until all are thus substantially equipped.

THE directors of the Merchants' Bridge & Terminal Company, of St. Louis, Mo; have at last adopted plans for a new bridge over the Mississippi. The plans will now be forwarded to the Secretary of War for final examination and approval. The location of the bridge as decided on by the Board of Directors, is about 2 miles north of the present bridge. It crosses the river at a slight angle from the foot of Ferry street near the water-works settling basins to the north line of the corporation boundary of Venice, on the Illinois shore. The bridge proper will be 2,425 ft. in length. Each of the 3 spans will be 522 ft. and the approaches each 425 ft. In length the bridge is a duplicate of the present bridge. If $500,000 of the bonds are taken by the people of North St. Louis, a wagon road will be constructed; if not, the bridge will be exclusively for railroad traffic. It is estimated to cost $1,500,000.

ELECTRICITY is being applied with some success to the lighting of omnibuses in London. The accumulators are placed in a small box beneath the body of the vehicle. The lamp stands in a frame, and is so arranged that, by being moved a little towards right or left it is lighted or extinguished. The frame is connected with the accumulator by a small hidden wire. One charge of the battery is sufficient for two days. The invention is in practical use on some of the London omnibus lines, and is said to work excellently.

The benefits paid to members of the Baltimore & Ohio Employes' Relief Association from May 1, 1880, August 31, 1888, were as follows:—

451 cases accidental death	$466,986.28
22,265 cases accidental injuries	297,045.27
14,247 cases surgical expense	92,472.60
41,900 cases natural sickness	620,819.53
864 cases natural death	328,805.82
79,737 cases, aggregating	$1,806,129.40

This report shows that since 1880 34 per cent. of the deaths that have occurred in the organization resulted from accident, while 66 per cent. resulted from natural causes. The proportion of accidental injuries and surgical expense to natural sickness is even greater. A B. & O. employe seems to have only about two chances of dying a natural death to one of dying as the result of an accident. Out of 22,265 cases of accidental injury a very large proportion, fully three-fourths, are from accidents in coupling cars.

THE indications now are that a new executive Department of Agriculture is to be created, for which there is no real demand or necessity, but that a Department of Public Works, for which there is urgent necessity, will be non-existent for some years longer. Politics, we suppose, is responsible for this reversion of good sense. It is claimed probably that Agriculture is a more important interest than Public Works; but the difference is that the Government has very little power or control over agriculture, while it has everything to do with public works.

THE MOST SERIOUS RAILWAY ACCIDENT of the week, and the most serious one since the Chatsworth, Ill., disaster of Aug. 10, 1887, was a rear collision Oct. 10 between two crowded passenger trains on the Lehigh Valley Railroad near Mud Run station, Pa. It was another excursion train affair like that at Chatsworth. The trains were numbers 4 and 5 of a series of seven special trains returning from a temperance convention at Hazleton Pa. The Lehigh Valley Railroad has a short cut from White Haven to Hazleton, but according to newspaper report, the superintendent of the division was afraid to trust the heavy trains over the bridges on that route, and sent all trains by the old road, around by Penn Haven Junction, and then up the Beaver Meadow branch to Hazelton. From White Haven to Penn Haven the track runs close beside the river, the embankment being high and steep in many places, and at Mud Run, the spot where the accident occurred, is from 60 to 75 ft. high.

The trains took the same route on the return, the first section leaving Hazelton at about 5 A. M., and the others following as rapidly as possible. The first three sections came through all right, but the fifth section, running at a good rate of speed, ran into the fourth section while it was standing on the track at Mud Run. The cars were all crowded to the doors, many women and children being among the passengers. The cars were smashed to pieces and hurled from the track, rolling down the steep embankments. Fortunately the river was low, or the cars would have gone into the water, and the loss of life would have been still more terrible. The number of persons killed is now estimated at over 70, and the number of persons injured is 25 to 50. Where the responsiblity of the accident rests is not yet known, but the accident was evidently due to the running of a number of heavy special trains at short intervals. The fault seems to lie with the engineer.

ANOTHER SERIOUS RAILWAY ACCIDENT was a head collision Oct. 6 between an east bound freight train and the Cincinnati & St. Louis express on the Baltimore & Ohio Railroad near Dickerson, Md. The accident was due to a mistake on the part of the freight-train crew. They say that they had orders to lay on the switch at Tuscorara and wait for two sections of the Pittsburg express, and the express train which caused the collision to pass. They allege, but it is denied, that they had been on duty continuously for 36 hours, and after seeing the first section of the Pittsburg express pass had gone to sleep at their posts to secure a little rest. They awoke as the second section went by, and as it was running on the schedule time of the Cincinnati and St. Louis express, they thought it was that train which had just passed, and therefore pulled out of the siding and came down the single track. Three men were killed and 7 injured.

HEAVY RAINSTORMS have occurred in Kansas during the week, and storms have done considerable damage in Ohio. Snow has fallen in New York and throughout New England.

THE McCORMICK offices in Chicago are being jacked up 6 ft. 5 ins. to meet the changes in street gradients. The building is 100 x 125 ft., six stories high and weighs nearly 20,000 tons. Several thousand screw-jacks are required and 300 men to handle them. The lift is about 1 ft. per day and it then takes a day to reset the jacks. The cost is estimated at about $40,000.

BRIDGE ACCIDENTS are reported as follows: On Sept. 29, a bridge on the Northern Pacific near Heron, Wash. Ter., was burnt.—On Oct. 2, the Anna Run bridge on the Duluth, South Shore & Atlantic Railway, was wrecked by a derailed car. Six cars went down.

IT is reported that a scheme is on foot at Winnipeg, Man., devised by City Engineer RUTTAN, for securing a valuable water power from the Assiniboine river, which runs through the southwestern part of the city and at ordinary stages is 30 to 40 ft. below the level of the prairie. It is proposed to build a dam (with removable section to be taken down at the spring freshets) which will raise the water about 25 ft.; and carry the water by canals to mills along the river front. The available horse power of the river at its lowest stage is estimated at 5,626 H. P., which could be increased to 10,000 by cutting a canal from Lake Manitoba to the Assiniboine at Baie St. Paul. The principal difficulty in carrying out the scheme would probably be in the construction of the dam and canals, which in the alluvial soil of which the banks and bed of the river is composed, would be difficult to make stable. The use of water power in such a severe climate, too, is growing more and more inadvisable as the cost of steam power continues to lessen.

INTERLOCKING CROSSING SIGNALS and derailing switches have been approved on the Michigan Central Railroad at its crossings of all other lines at Battle Creek, and on the Chicago, Kalamazoo & Saginaw Railroad, at the crossing of the Michigan Central at Hastings. We hope to see so many of such interlocking systems ordered at railway grade crossings in the near future that it will be impossible to chronicle them all.

A TERRIFIC EXPLOSION of a powder mill near Roanoke, Va., Oct. 6, appears to have been caused by malice. About 400 kegs of powder and 3,000 lbs. of dynamite exploded, creating a hole 35 ft. in diameter and 15 ft. deep beneath it, and causing one death.

THE CITY OF CHICAGO is having another unpleasant experience as the result of a strike. Owing to a disagreement regarding wages, the street car employés on the lines in the city owned by the YERKES, ELKINS and WIDENER syndicate have struck, tying up the North side and West side lines and the new cable road as well. The party most injured by the affair is the long-suffering public, who are walking back and forth to their business or jolting over the pavement in express wagons.

The Hyatt Water Filtering Plant at Long Branch, N. J.

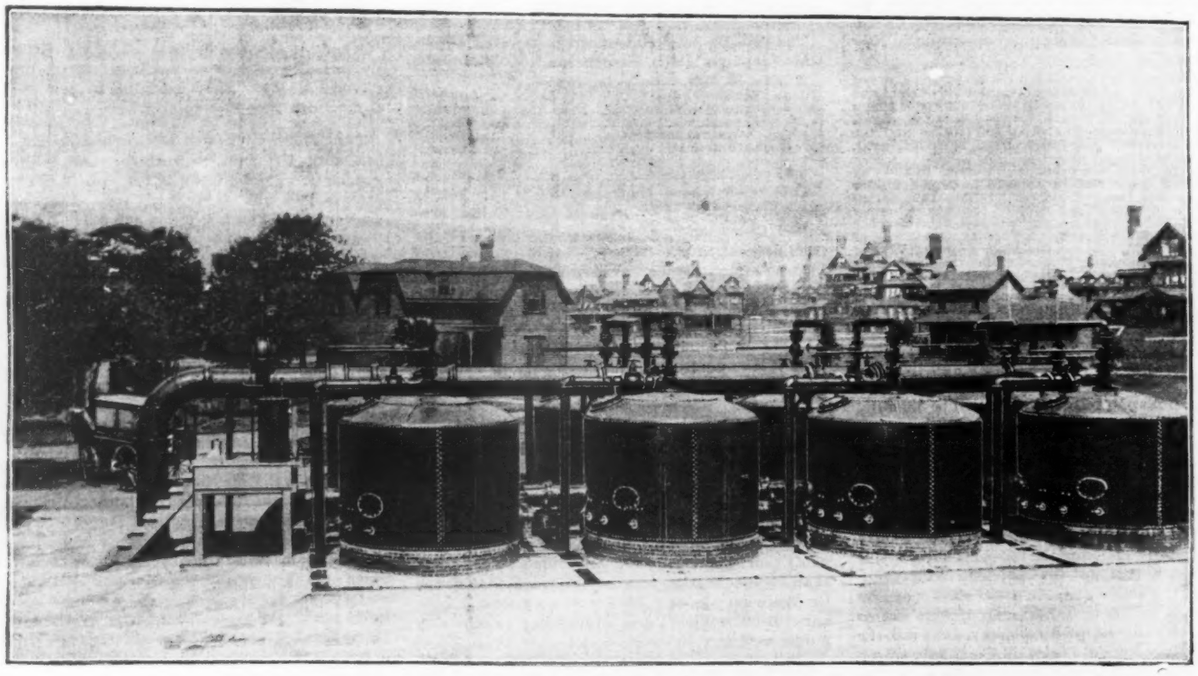
Long Branch, the chief warm weather resort on the New Jersey coast, obtains its water supply from springs and a small creek; and as is usual with the water about there it is somewhat discolored, especially in the season of greatest demand. This evil has been remedied lately by the erection of a Hyatt filtering plant which has been visited by a representative of this journal and is illustrated in this issue.

The water is collected in a pond in the rear of the pumping works and is aerated before it enters the pump-well by a system invented by Mr. HYATT, which is as simple and cheap as it is seemingly efficient. This is a 16-in. pipe sunk vertically 100 ft. into the ground at the bottom of a small shallow well communicating with the supply pond. This pipe is plugged at the bottom with cement and is divided into two parts by a vertical partition; near the top a half-diaphragm closes one of these halves of the pipe, and just under this diaphragm is an elbow with a horizontal pipe leading to the bottom of the pump-well. The water from the small well enters in the open half of the pipe, and, passing down with great velocity, sucks in a large volume of air with it; this mingled air and water ascends in the other half of the pipe and then enters the pump-well by the horizontal pipe referred to. The efficiency of the device is attested by a constant and very considerable rising of air-bubbles from the bottom of the pump-well.

The battery of filtering tanks is located just outside of the pumping works as shown, and the pumping main passes between the two rows of four tanks each which make up this battery; the supply main is connected with the filters by a by-pass suitably arranged for the purposes to be described. The Hyatt system combines mechanical and chemical purification by first treating the water with an alum solution before it passes through the sand and coke filter beds. This alum solution, about one-half grain to a gallon of the water to be treated, is added as follows:—A small percentage of the unpurified water passes through an attachment to the main filter containing lumps of alum; a minute quantity is thus dissolved, and, passing into the main filter, is mingled with the water before it passes the filter beds. The clay in suspension and other earthy matter has the effect of precipitating the alumina in the alum, and causes it to separate all through the water in the form of gelatinous threads; these threads bring together, or coagulate, the finely suspended matter in the water and the filtering material then easily and completely arrests it, together with all of the alum. The claim is made, and supported by tests, that this system not only clears the water of all impurities in suspension, but also removes a great part of objectional matter in solution.

The filters are made of sand with from one-fourth to one-third the volume of prepared coke added thereto. These filters are cleaned daily by simply shutting off the clean water main and then reversing the flow of the water from the supply main communicating with any one tank. A vertical shaft with horizontal arms passes through the filter and acts as an agitator in stirring up the mass and allows the current to remove and carry to a waste-pipe all impurities arrested in the filter-bed. The cleaning operation is independent for each tank, and occupies from 10 to 15 minutes of time for each, the waste water being allowed to run until it shows a clear discharge. The man who attends to the pumps can easily find time to do the cleaning as well.

The plant at Long Branch will be protected by a suitable building before winter. It is designed for a daily supply of 2,000,000 galls., but 3,000,000 galls. have been passed through it successfully; thus repeating the experience at the Atlanta, Ga., plant of Hyatt filters, where tanks guaranteed for 3,000,000 per day actually filtered over 2,000,000 galls. in 12 hours. The cost of the Long Branch plant, including aeration, outside piping, foundations and a suitable building, was $30,000. These 8 filtering tanks are each 10 ft. in diameter and 9 ft. high; the Atlanta filters are 10 ft. in diameter and 13 ft. high, and they cost $55,000 in all.



The Hyatt Water Filtering Plant at Long Branch, N. J.

Our representative closely examined each detail of the plant at Long Branch, compared the yellow supply water with the clear and pure effluent water and saw the process of cleaning, and he can testify to the simplicity of the process, its rapidity of action and thoroughness. It is no faint praise to mention here that a similar but more minute and careful examination into the principles and working of this system, by the Committee on Science and Arts of the Franklin Institute, resulted in the award to Mr. HYATT, its inventor, of the JOHN SCOTT Legacy Premium and Medal.

THE last truss of the new Cleveland viaduct was placed in position on Oct. 2. Erection was commenced in Aug. 1887, at one end, and in Oct. 1887, at the other. The total floor length is 2,840 ft., and the viaduct is 92 ft. high at the Nickel Plate crossing, 101 ft. high over the river, and 106 ft. high over Walworth run. The drawbridge is 236 ft. long. The engineer of the bridge was Mr. W. M. HUGHES, under Mr. W. P. RICE, City Civil Engineer. The King Bridge Co. built it.

Bad Work on the New Croton Aqueduct; How Detected and How Repaired.

It has long been an open secret that bad work had been done in the lining and backing of parts at least of the New Croton Aqueduct, and in order to be enabled to give the real facts in the case we have caused a careful personal examination to be made of about five miles of the aqueduct tunnel now under reinspection and repair, with the following results:

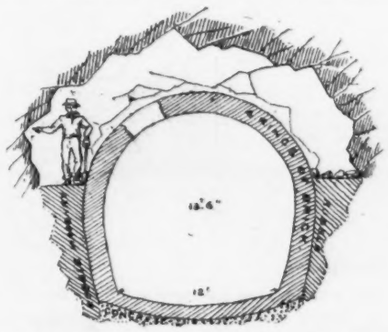
According to the testimony given at a hearing granted to the contractors in January last, concerning the charges of bad work on the upper end of the tunnel, the trouble commenced soon after work on the lining masonry was pushed in earnest. The engineer of the First Division seems to have been particularly active and sharp in his inspection, and considerable work was being constantly torn down and rebuilt under his orders, and it is understood that little, comparatively, now remains to be repaired on the work in his charge. The parts visited last week between shafts 6 and 11 A, belong to the Second Division, and while this portion of the tunnel had been passed upon as complete and even re-inspected and repaired by the engineer in charge here, it was evident that there was a decided lack of vigilance in inspecting the masonry as originally erected, and an equal carelessness in the re-inspection and repairs. This is a charge in which contractors, city inspectors and the Division Engineer and his assistants must bear their proper proportion of responsibility, though it is a matter that can be more properly discussed elsewhere.

The re-inspection, recently authorized by the Commission and the Chief Engineer, over the whole length of the tunnel is conducted as follows:—A stout, able-bodied workman, a Cornish miner by the name of GILL in this particular part of the tunnel, does the sounding with a hexagonal ¾ in. steel bar about 11 ft. long, and upset at the upper end into a rounded head. This workman passes over a section of 100 ft. of tunnel at a time, first striking a hard blow on the key at intervals of about 5 ft., and then in the same manner testing the haunches and side walls on each side. The ease and certainty with which this bar of steel picks out voids behind the masonry is remarkable to one who has never seen it done; vacancies the size of a barrel, and even dry back-rings in the arch are revealed to the expert in sounds, and a large cavity gives back a rumble that seems as if coming from the bowels of a bass drum. As far as can be learned, GILL and his sounder have not yet told a false tale and caused good masonry to be cut out; and as it would be uncharitable to suppose that all masonry was bad,

very considerable virtue must be ascribed to this method of testing.

When a suspicious spot is found, it is marked by the inspecting engineer, and later that portion of brickwork is cut out and whatever it conceals is revealed. Now as to what our representative saw on the part examined by him through the test openings cut. The most common form of bad work was in the side wall backing; that wall was laid in lengths of 50 ft. and in two installments of work between the invert and the springing line of the arch, with often a considerable interval of time between the laying of the two parts. When examined these side walls showed a line of fairly laid rubble just where each separate piece of work was completed, but under this was dry stone packing, generally dumped in without even an attempt to lay the stone flat in a respectable dry wall; this dry backing was full of voids more or less large according to the space to be filled and the size of stone used.

The brick arch and side wall masonry also showed defective work at a number of the 20 or more openings examined, chiefly in the lack of mortar in the inner rings, and sometimes in the careless manner in which the brick was laid in the rear portion. Continuous stretches of key, in one case nearly 3,000 ft. long, were noticed as rebuilt, and from portions examined, very properly so. This key had been laid with the first ring, and sometimes the second ring, well imbedded in mortar; but the third and fourth rings were simply stuck in a thin bed of cement with the joints between the bricks very open. Bricks were removed by hand, in several



Sketch of a Vacancy over Arch in the New Croton Aqueduct.

places, by our representative, from the outer ring of the key. He also learned from the testing party that on one occasion Mr. GILL gave too vigorous a rap on the key with his steel sounding rod and brought some loose bricks down about his ears as the penalty; as the arch has a minimum thickness of 12 in. this incident can only be explained by extraordinary muscular development in Mr. GILL; or by unusually bad brick masonry.

Bad brickwork and stone masonry is a matter for which the contractor's foreman and the city's inspectors must directly answer. But great cavities containing no masonry of any kind, and yet paid for as masonry, belong to a class of fraudulent work for which others must be held responsible as well. The cross-section here shown is not based on any hearsay evidence, but is made from personal examination and such rough measurements as were possible; it is simply an attempt to show a cavity which was actually entered, though it was the most roomy of the number open at the time of the visit. This particular hole was about 50 ft. in length on the axis of the tunnel, and was only limited at the ends by the rock roof coming too near to the extrados of the arch to permit further progress; but stones thrown through the end spaces showed that there were still other vacancies beyond. The top surface of the haunch-work showed a pile of loose stone utterly innocent of mortar, though it was estimated and paid for in this particular place as rubble masonry at $6.00 per cu. yd., as was in fact the great void above it.

Some genius connected with the work discovered that it was a waste of material and labor to send empty cement barrels up the shaft, and so a number of these, to the extent of about 820 barrels, discovered to date on this Second Division alone, were stowed away over the haunches. Ten of these barrels were seen removed from one void over the arch, on the occasion of the visit referred to, and the heads of several more were seen "in place" in a pile of loose stone backing. The inspectors state that cases were uncovered, where barrels had been used to support a brick-layers staging, and the barrels and planks were both finally buried in masonry started on the staging as it stood. On the first Division the original inspection was more rigid and the total of barrels was 65.

This bad masonry is now being torn down and rebuilt and the voids properly filled, at the contractors' expense, as fast as they are discovered. And, to insure against minor omissions of cement in the backing and arch, grouting is in progress, which is to extend over all suspected work throughout the tunnel. This grouting is done as follows: Seven 2½ in. holes are drilled through the brickwork around the tunnel above the invert; these holes are 10 ft. apart horizontally and alternate with each other in such manner as to insure against any miss by reason of a single layer of cemented work. These holes are plugged over a certain section, and into one of them is inserted the nozzle of a hose connecting with a force-pump. The pump has two vertical cylinders with plungers in each worked by a brake and these are provided below with simple clack valves. The grout is made of Akron cement one part and sand one part; these two ingredients are mixed dry on the surface and sent down into the tunnel in barrels. Water is then added until the grout is thin enough to run and the mixture is injected into the holes under a pressure claimed to be somewhere near 150 lbs. to the sq. in. This grouting seems to be most thorough and efficient in closing up crevices out of sight, and when examined has been found well set at a considerable distance away from the pump. As might be supposed, the consumption of cement is great, over 150,000 barrels to date; and while the complaint has been made that cracks and crevices in Westchester County generally are being filled, the Italian stone mason has probably left voids much nearer at hand sufficient to account for the volume used.

In conclusion, it may be said while bad work has been done on this Aqueduct, the contractors responsible are making it good at their own expense; and sufficient money has been retained to finish this work in a manner that should allay all popular fear as to the ultimate quality of the masonry throughout and its ability to fully answer the requirement of this masonry.

The Canadian Pacific Railway.

III.

The rapidity with which the Canadian Pacific Railway was constructed remains even now, on the whole, the greatest feat of railroading ever accomplished, in view of all the financial and construction difficulties which had to be contended with. Such results, of course, can never be accomplished without the concurrent assistance of a great number of men in various capacities, to all of whom a portion of the credit and honor is due. But as a rule, in all such cases, and certainly on the Canadian Pacific, the controlling mind at the head is the decisive factor, and to him only the whole credit is due in one sense, that without him the best assistants can accomplish nothing, while if his work be well done, a considerable sprinkling of poor assistants will not avail much for evil, for the short time that they are likely to remain in their positions. In this sense the credit for the rapid construction of the Canadian Pacific belongs to two men, in about equal degree, Sir GEORGE STEPHEN, the able President of the Company, on whom the burden of all financial and Governmental arrangements chiefly lay, and Mr. W. C. VAN HORNE, the Vice President and General Manager, now the President, who has been the executive head from the first, and who has to a very unusual extent and with very unusual success, personally supervised and controlled the whole technical management of the enterprise from the Atlantic to the Pacific. In all such matters the final criterion is success, and certainly there are few or no examples of such brilliant and complete success in the administration of so vast an enterprise. That this is so is apparent at once from the facts of construction, which in brief were these:

In 1871 British Columbia entered the Confederacy, and Government surveys for the Pacific railway were begun and prosecuted till 1880, most of the mountain work, however, proving of no avail.

In 1875 construction was begun by the Government on the Lake Superior Manitoba section, and in 1879 on the Pacific section, the work on each being prosecuted continously by the Government to completion, when the two sections thus built (aggregating 430 and 213 miles respectively, mostly heavy work, at a total cost of over $30,000,000 or nearly $50,000 per mile) were turned over to the company as a gift, no very remarkable construction record being made, although it was far from a bad one in view of its being nearly all heavy work.

Feb. 17, 1881, the present company was incorporated, and almost immediately began work.

By the end of 1881, or as a result of the first season's work, the completed system, including both line built and acquired by lease or purchase, consisted of

	Main Line	Total.
By the end of 1881	456	600
" " " " 1882	1082	1382
" " " " 1883	1900	2276
" " " " 1884	2682	3995
" " " " 1885, (Nov. 17) last spike driven	2891	4338
It now consists of	2906	4970
The increase of 1882 was	626	782
" " 1883 "	818	855
" " " 1884 "	792	1758
" " " 1885 "	109	343
" " " 1885 to date	15	632

With the history of the branches we need not concern ourselves. They largely (1874 miles) consist of leased lines, and most of the rest have been acquired without construction. The history of the main line construction is more in detail as follows.

At the end of the season of 1882 the rails were down from Montreal to North Bay, 364 miles; there was then a long gap to Fort William. Between that point and Winnipeg, on the Government work, construction trains were running, but it was not turned over to the company; 605 miles west of Winnipeg (against 185 at the beginning of the year) and 113 miles east of it were finished.

At the end of 1883, 84 miles more had been built from the Montreal end, and 67 miles east from Port Arthur, the total gap being 445 miles; 7,000 men had been employed on it during the season; Port Arthur to Winnipeg (Government) was likewise complete, and likewise the entire distance across the plains to the summit of the Rocky Mountains, 2,384 miles from Montreal, 961 miles from Winnipeg, which was the first point at which heavy mountain work was struck, although it was nearly 70 miles within the mountains, all of it in scenery of the greatest grandeur. There was likewise a considerable section of Pacific work nearly complete, so that very early in 1884, trains were running 137 miles from the Pacific terminus.

At the end of the next season, of 1884, the entire gap north of Lake Superior had been closed; the track had been carried forward 94 miles further through the heavy Rocky Mountain work, to the summit of the second range crossed, the Selkirks, 2,478 miles from Montreal (1,055 miles from Winnipeg) and eastward from the Pacific, 213 miles from the coast, leaving a gap in the mountains of only 203 miles, but covering some of the heaviest and most troublesome work on the line. This gap was closed on Nov. 7 of the next season at Craigellachie, 1,130 miles from Winnipeg (2,553 miles from Montreal) and 338 miles from Port Moody, so that 169 miles of track was laid in this season from the Atlantic end, and only 34 miles from the Pacific end.

The main line may be subdivided thus:

	Miles.
Montreal to Ottawa, purchased of Quebec Province	120
Port Arthur to Winnipeg, built by Government and given to Company	430
Port Moody to Savanas Ferry, built by Government and given to Company	213
Built by Company, 1881 to 1885 inclusive	2,128
Total main line up to end of 1885	2,891

From the preceding data we find that the progress of the Company work west of Winnipeg, from the time the contract was let to Messrs. Langdon, Shepard & Co., of St. Paul, March 11, 1882, who built across the plains to Calgary, was as follows:

Prior to letting of contract	185	
Season of 1882	480	miles.
" " 1883	356	"
" " 1884 (mountain work)	94	"
" " 1885	75	"
Total Winnipeg to Craigellachie	1130	"

The progress of the work from Ottawa to Port Arthur, 873 miles, was as follows:

Prior to Season of	1881	199 miles.
" "	1882	45 "
" "	1883	184 "
" "	1884	445 "
Total		873 "

The Pacific end progressed thus:

	1879 to end of 1883	137 miles.
Season of	1884 (end of Gov't work)	76 "
Season of	1885 (Company work)	125 "
Total		338

We are compelled by lack of space to postpone details of the track-laying records by which this remarkable progress was achieved, to another issue.

A New Planimeter.*

BY PROF. HELE SHAW, M. INST. C. E.

The want has long been felt of some instrument for measuring areas which, while possessing the accuracy of the Amsler planimeter, would have the great advantage of giving a reading by means of a pointer moving over a dial face of such magnitude as to obviate the use of a vernier. The author, four years ago, brought forward a class of sphere integrator under the name of the sphere and roller mechanism, in which, by employing the rolling of two surfaces in contact with each other, instead of the combined slipping and rolling of the Amsler type of instrument, a satisfactory solution of the problem appeared to have been attained. Various forms of these integrators were thoroughly tested, but with unsatisfactory results, inasmuch as they always gave a slight error of variable amount; and it has since been found by means of specially designed experiments that the universally accepted principle of rolling contact relied upon in their design did not hold in practice under the particular conditions in which it was there applied. The sphere planimeter, which is now exhibited for the first time, really belongs to the Amsler class of integrator, though resembling in external appearance the author's previous instrument above referred to, since one essential feature of it is a sphere.

The instrument consists of a bent bar $A\ A$, one end of which forms the fixed center C, upon the surface containing the area to be measured. The other end is jointed at E to a frame F, which guides a sphere S by means of 4 rollers $R\ R\ R\ R$, the centers of these rollers being carried upon small rigid brackets. The frame which supports the dial $D\ D$ is continued by means of a bar, at the end of which is pointer P, which is passed round the perimeter of the figure to be integrated. Upon the sphere rests a small measuring roller or integrating wheel M, the axis $H\ H$ of which carries the recording index I and a pinion K.

This pinion gears with a wheel 10 times as large, working on the back of the dial, by means of which higher readings are recorded. Undue pressure between the measuring roller and the sphere is prevented by means of the roller N, which is attached to the bar $A\ A$.

The theory of action may be thus explained: Suppose the area of a rectangular figure a, b, c, d (Fig. 4) to be required, and suppose first that instead of the pointer P moving over the perimeter, the sphere itself is rolled along it, also that instead of the center of the joint E moving in the arc of a circle as it would do in the actual instrument that it moves along the line $O\ X$. As the sphere passes over the figure it transmits an exactly similar motion, but in the reverse direction, to the roller $m\ m$ resting upon it as the roller would receive if moving in contact with the surface of the paper. The roller thus slips as well as turns, the relative value of the two effects depending respectively upon the ratio of the two sides, $R\ Q : R\ P$ of the triangle $P\ Q\ R$. These values are the absolute quantities for a movement $P\ Q$ of the center of the sphere P. Thus in moving a distance $P\ Q$ along the line $a\ b$, the turning of the roller $= P\ R = P\ Q \sin < R\ P\ Q$. Similarly for a movement along $c\ d$, the turning depends upon the sine of the angle of inclination of the roller. Draw perpendiculars $P\ N$, $P_1\ N_1$, to the line $O\ X$ from the center of the sphere, and let

*Read before Section G of the British Association at Bath.

$$h = P\ N$$
$$h_1 = P_1\ N_1.$$

Let the angles made by the center line $E\ P$ with line $O\ X$ be respectively α and β. Then since the triangles $P\ Q\ R$ and $P\ E\ N$ are similar, and also the triangles $P_1\ Q_1\ R_1$ and and $P_1\ E_1\ N_1$,

$$< P\ E\ N = < R\ P\ Q = \alpha$$
$$< P_1 E_1 N_1 = < R_1 P_1 Q_1 = \beta.$$

Then for a movement of P along the line $a\ b$,

$$\text{Turning of roller} = a\ b \sin \alpha,$$

and for a movement along $c\ d$, the direction of motion being now reversed—

$$\text{Turning of roller} = c\ d \sin \beta.$$

In moving down the side $a\ c$ the motion of the roller is equal and opposite to that which it has in moving up the size $d\ b$. Therefore, finally,

$$\text{Total turning of roller} = a\ b \sin \alpha - c\ d \sin \beta.$$
$$= a\ b\ (\sin \alpha - \sin \beta)$$
$$l = \text{length of center line } E\ P$$

If $h = l \sin \alpha$

$h_1 = l \sin \beta$.

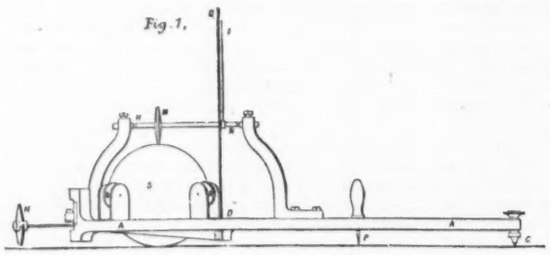


Fig. 1.

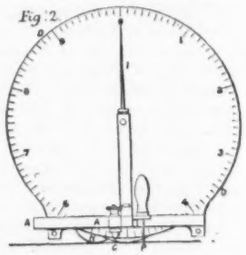


Fig. 2.

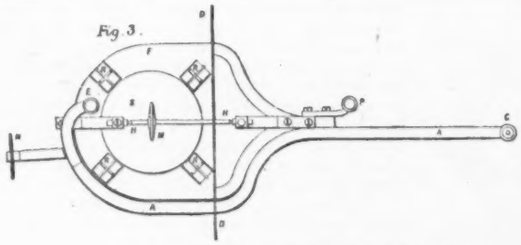


Fig. 3.

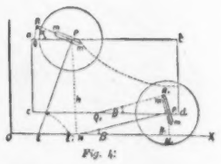


Fig. 4.

A New Spherical Planimeter.

$$\text{Turning of roller} \quad a\ b\ (h - h_1) \times \frac{1}{l}.$$

$$= a\ b \times c\ d \times \frac{1}{l}$$

= area of figure × constant.

Using a suitable scale, the area of the figure is therefore shown by the reading on the dial.

Now it is clear (1) that so long as the pointer moves over the figure, the sphere may be moved to any part of the bar without affecting the result; (2) that so long as the pointer returns to the initial position, the end E need not move along a straight line but may travel in the arc of a circle; (3) that the reasoning applies to any form of figure, such as the indicator diagram shown in dotted lines, the area of which would be correctly given by passing the pointer round its perimeter.

It may be remarked that the action of the sphere is simply to transmit the motion of the roller, and therefore so long as no slipping takes place on the surface of the paper beneath, the record is given with the same degree of accuracy as with the Amsler planimeter, but with the important advantage of a large dial reading, there being only the simple difference that the pointer must in the sphere planimeter be moved in the opposite direction round the perimeter of the figure to be measured.

One feature of interest in the instrument is the use of the four guiding rollers $R\ R\ R\ R$, which are in contact with the great circle of the sphere formed by the intersection of the horizontal plane through its center, and thus allow the sphere to turn without resistance in any direction. To this end the rollers are carried in rigid brackets, and do not exert any pressure upon the sphere, but just keep it in position in the frame. They are pivoted on very fine centers, and they are of steel with polished edges, so that even when the sphere is moving in a direction causing its axis of rotation to pass through one of these edges, the motion of the sphere is not appreciably retarded by frictional resistance. Hence the planimeter is found to be correct up to the limit of accuracy to which records can be read on the dial face.

Reconstruction of the Chaudiere Suspension Bridge at Ottawa, Canada.

We are indebted to the Chief Engineer of the Department of Public Works of Ottawa, Mr. HENRY F. PERLEY, for specifications and plan of the existing suspension bridge over the Ottawa river. Tenders are invited for the removal of the towers, cables, anchors and roadway of the old bridge and for replacing the same with an iron or steel truss bridge of one span. The notice is dated Aug. 13, and the new bridge must be completed before May 1, 1889.

The structure is for highway purposes and the new truss must not be less than 236 ft. long, 45 ft. wide out to out, and proportioned to carry its dead load, 2000 lbs. per lin. ft. of live load and in addition to these an allowance for snow and "the accumulation of ice on one truss in winter caused by spray from the Chaudiere Falls".

All tenders require the enclosure of an accepted bank check, payable to the order of the Honorable the Minister of Public Works, and equal to five per cent. of the amount of the tender. The specification can be secured from the Chief Engineer at Ottawa, Can., or seen at this office.

THE NEW UNION RAILWAY STATION at Indianapolis, Ind., was informally opened on Sept. 17. It is one of the costliest and most convenient structure of the sort in the country, the buildings alone costing $1,200,000. The main building is of the Romanesque style of architecture with the exception that the tower approaches the old English school prevalent in castles 3 centuries ago. Sheds 900 ft. long and 100 ft. wide provide trackage for 18 trains at one time. There is an extensive system of tunnels and viaducts in connection with the depot, but they are not yet completed, and the final opening cannot be held until these and some other details are finished.

THE MISUSE OF THE THAMES.—The conservators of the river Thames and the inspectors of fisheries have found a new grievance in the present treatment of that stream. For a long time the Metropolitan Board has been making a sewer of it by ejecting therein about 100,000 tons of suspended matter annually. But now it is found that district boards are making a "dust bin" of it as well by practically dumping there a large proportion of the rubbish and road scrapings of the city. As the volume of London house refuse is figured at about 750,000 tons annually, and only a part of this is actually utilized, there is little wonder that the fishermen complain that "old cocoa-nut matting" smothers the young oysters and that nets bring up such unsought trophies as chimney-pots, gridirons, coal scuttles, etc. There is certainly room for complaint, but, in the words of our Boss TWEED, what will they do about it?

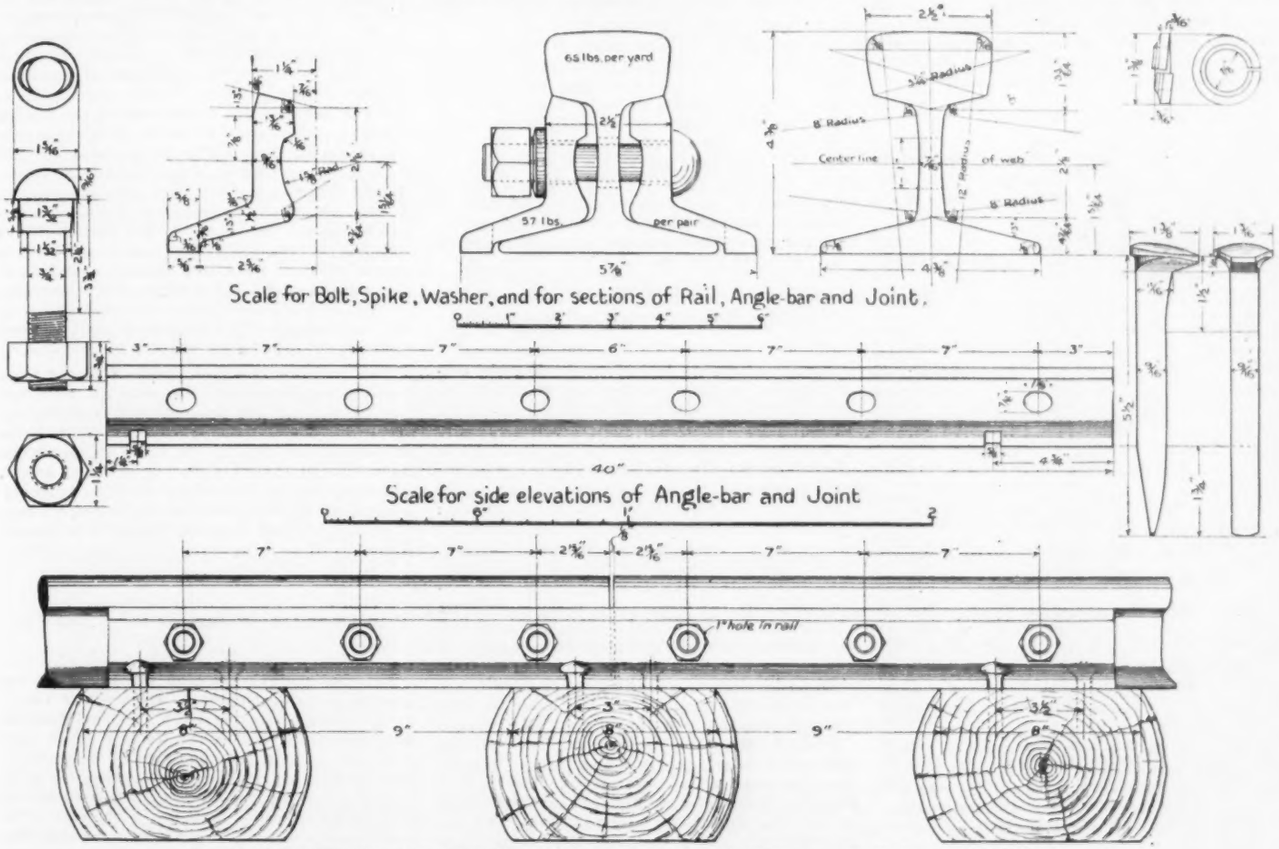
Standard Rail and Joint, Denver & Rio Grande Railway.

The accompanying cut of this new standard, approved June 26, 1888, is another example of the strong tendency to modify old types of both rails and joints. The joint is of the three-tie type, to which there has been such a decided leaning in recent practice, 40 ins. long and weighing 57 lbs. per pair, being about the average of recent practice in that direction Despite the fact that the head of the rail flares inward instead of outward the bearing surface of joint on under side of head is good, although it would seem as if it might have been made still better without harm by making the upper inside corner of the angle bar sharper. In a bearing of this kind every extra sixteenth counts.

We have often expressed our doubts as to whether this type of joint will prove permanently satisfactory. To a certain extent, it seems to us, its extra length only furnishes greater leverage for its own destruction, while the difficulty of securing an even bearing on three ties is undeniable. If the middle tie be low, the bar is so long as to be in great danger of taking a permanent set. If the middle tie be high it would seem as if there should be a corresponding danger in the other direction. But the proof of the pudding is in the eating, and these joints seem so far to be giving good satisfaction. Whether they will continue to do so, we must confess seems to us doubtful. The fish-bar and the short angle-bar were both hailed on their introduction as the final solution of the joint problem, and rapidly spread all over the land; yet they have at last been found deficient.

We are unable to see how greater length can permanently modify the most objectional tendency of the angle bar, to wear unequally on the upper edge, most right at the joint and tapering rapidly off from there to nothing. The tendency arises from the greater weakness of the rails at the ends, which makes them spring down under load, and of course brings the hardest blow right at the very middle of the joint. When wear there has once begun, a hammer action at once sets up which greatly increases the rate of wear, and if the fish-plates were continuous and 30 ft. long instead of 40 ins. it would seem as if the same cause would still exist and produce the same effect. We therefore reserve our judgment as to the permanent adequacy of this type of long joint, beyond chronicling the undoubted fact that they are making a better record so far than the shorter joints have done.

The rail section is, we believe, excellent. The absurd theory that the rail corner should be rounded off to "fit the flange" and so enable grinding wear to begin at once, is given no countenance, but a radius of 5-16-in. is used, and the inward slope of the head tends still further to postpone the day when grinding side-wear of the flange shall begin. A report of the committee of the American Society of Civil Engineers which has had the question of the form of rails and wheels under consideration, will shortly appear, and pending the appearance of that report we will not enter further into details as to the reasons in favor of such sections as that shown, than to say that it substantially corresponds with the indications of the committee's report.


65 lbs. per yard
57 lbs. per pair
Scale for Bolt, Spike, Washer, and for sections of Rail, Angle-bar and Joint.
Scale for side elevations of Angle-bar and Joint
1" hole in rail

Standard Rail Section and Angle Bar—Denver & Rio Grande Railway. R. E Briggs, Chief Engineer.
[One-sixth and one-third full size.]

The Washington Aqueduct Frauds.

A Washington correspondent of the New York *Times*, gives some details of the scandal lately unearthed in connection with the aqueduct now practically completed under the supervision of Government engineers for the new water supply of Washington, D. C. The following is an abstract of this letter:

The tunnel is 21,400 ft. long, and the estimated cost was $599,534; it has actually cost over $1,000,000. This excess is partly due, however, to slow appropriations. The tunnel has been driven its whole length, and about one-half of its length has been lined with masonry. According to the late reports, a large part of the lining already put in is worse than worthless, and must be pulled down and rebuilt. As the tunnel will be under great pressure, this bad work is exceedingly dangerous to its very existence.

The detected frauds are in the backing of the arch masonry and in the brickwork itself just beyond the outer first or second rings; this backing, when found to every gang of masons. Messrs. BECKWITH & QUACKENBUSH state that under their sub-contract with BRENNAN & PALMER they paid upon the certificate and acceptance of work by the Government engineers, and hence paid as much for the bad work as for the good.

The claim is made that the engineer officers in charge have conscientiously discharged their duties, to such an extent that Lieut. TOWNSEND has seriously impaired his health by his almost constant presence in the tunnel. Maj. LYDECKER has also frequently visited it and has personally detected and caused bad work to be torn down and inspectors and workmen discharged.

The fact that the inspectors were only paid $75 per month will most probably account for the employment of inexpert and worthless men; it is not to be supposed that on a public work of this character, more or less under the influence of politics, honesty and capability can be insured at this price.

The correspondent referred to makes many charges of changes of plan, faulty engineering, and the impropriety of a tunnel at all through this rock; but as he acknowledges that access to documents was denied him, he is hardly in a position to sup-

The original contractors were Messrs. BECKWITH & QUACKENBUSH, of New York, who sublet the greater part of the lining work; but as they are the only contracting parties recognized by the Government, they will be held responsible for the mischief done. The work was done under the engineer officers of the Government in charge of the Department.

The engineers from Gen. CASEY down, are naturally reticent, and the War Department has referred the whole matter to Maj. LYDECKER, the engineer of the Department, for investigation and report. The contractors blame the sub-contractors and Government inspectors, and the engineers say the inspectors are at fault and "two of the latter have already been suspended;" there was one inspector

port these charges, even perhaps less fitted by experience to discuss them. In any event the frauds detected have nothing to do with the plans of the works, they are frauds of execution; in them, however, contractors, inspectors and engineers must share the blame.

TILE DRAINAGE IN ILLINOIS. — The amount of drainage in Illinois, as it exists to-day, is so large that it will surprise any one who looks upon the figures given below. These figures are furnished by the State Agent, from his official report to be presented to the State Legislature at its next session. The amount of open ditches under the State Drainage Law is not yet known, but, so far as reported, their cost will amount to over $2,000,000, while the cost of tile drainage reported to this date will reach the sum of $18,000,000, and the length of the tileage drains exceeds 700,000 miles. The counties that have put down the most tile are in the order named—McLean, Livingston, Champaign, Vermillion, La Salle—each over 20,000,000 of feet, or 4 to 5,000 miles. The list is given by counties, so that the reader may localize the improvements and learn the lengths laid down in each county:

Counties.	*Feet.*	*Counties.*	*Feet.*
Adams	194,345	Livingston	23,207,404
Bond	6,340	Logan	8,1-5,165
Boone	178,524	Macon	14,630,791
Brown	1,282,983	Macoupin	1,866,281
Bureau	8,424,388	Madison	304,365
Calhoun	37,200	Marion	3,782
Carroll	205,393	Marshall	4,055,675
Cass	3,441,289	Mason	38,250
Champaign	20,696,468	Massac	550
Christian	7,776,789	McDonough	2,503,377
Clark	324,157	McHenry	294,031
Clay	26,925	McLean	25,756,404
Clinton	15,655	Menard	2,851,263
Coles	6,180,541	Mercer	3,147,746
Cook	1,188,787	Monroe	9,032
Crawford	507,665	Montgomery	238,168
Cumberland	307,924	Morgan	473,610
DeKalb	8,856,080	Moultrie	4,405,048
DeWitt	6,562,432	Ogle	2,050,443
Douglas	10,028,332	Peoria	6,510,988
Dupage	2,869,050	Perry	2,400
Edgar	12,483,576	Piatt	8,048,222
Edwards	35,630	Pike	318,007
Effingham	36,395	Putnam	2,313,771
Fayette	9,195	Randolph	7,134
Ford	3,863,071	Richland	33,494
Fulton	6,684,080	Rock Island	927,171
Gallatin	134,478	Saline	48,457
Greene	1,934,652	Sangamon	8,461,388
Grundy	6,792,706	Schuyler	1,487,560
Hamilton	1,740	Scott	499,670
Hancock	968,479	Shelby	3,318,457
Hardin	16,665	Stark	4,306,084
Henderson	862,647	St. Clair	372,779
Henry	6,329,532	Stephenson	75,623
Iroquois	8,594,086	Tazewell	9,606,752
Jackson	2,200	Union	585
Jasper	375,680	Vermillion	20,362,947
Jefferson	1,876	Wabash	352,373
Jersey	65,146	Warren	5,675,946
Jo Daviess	33,624	Washington	10,315
Johnson	650	Wayne	41,027
Kane	4,463,235	White	666,882
Kankakee	2,700,997	Whiteside	364,769
Kendall	6,165,005	Will	11,662,850
Knox	7,877,381	Williamson	600
Lake	597,985	Winnebago	246,962
La Salle	20,331,466	Woodford	12,238,315
Lawrence	93,535		
Lee	496,791	Total	363,466,830

Chicago *Tribune*.

German Street Railways.

"*The Zeitschrift für Transport-wesen und Strassenbahn*" gives the following information in regard to German street-railways:

This mode of transportation is in use in 60 towns in Germany; the total length of track in 1887 amounting to 1,142,680 metres (710 miles), and the number of passengers carried in the same year was 265,741,350. The city of Berlin had 258,782 metres (161 miles) of track, and forwarded 107,119,716 passengers.

Out of a total of 10,025 employés of the Great Berlin Horse Railway Co., there have been 611 accidents (8 fatal) in the last 5 years.

On the three Berlin street railways, during the 6 years 1882-87, there have been in all 3,350 accidents to passengers and to persons crossing the tracks—2,051 without serious hurt, 1,106 slight injuries, 173 severe injuries and 20 deaths.

An inquiry into the causes of accident showed that 419 were run over by the horses; 536 were injured in getting on, and 1,981 in alighting from moving cars; 414 in collisions with and falls from other vehicles and such causes.

In the last two years the record of the Berlin roads shows that 1 passenger out of every 383,128 was hurt—1 out of 447,966 was slightly wounded, 1 out of 2,830,806 severely wounded, and 1 out of 40,764,000 was killed. In this same period 1,791 accidents were due to getting on or off cars in motion: 69.46 per cent. of these accidents did no serious harm; 479 persons were slightly wounded; 63 received severe wounds; 5 were killed. It is worthy of note that 75.13 per cent. of the total number of accidents came from this cause.

Railways in Germany.

The length of lines of all German railroads was as follows, in the years named:

	1883-'84	1884-'85.	1885-'86
	Kilo.	Kilo.	Kilo.
Main lines	34,881.6	35,619.5	36,164.7
Standard gauge side tracks	1,136.6	1,221.2	1,417.3
Narrow gauge tracks	107.3	107.3	147.3
Rack-rail lines	1.5	3.5	7.5
Total	36,127.0	36,953.5	37,736.8

At the close of fiscal year ending March 31, 1886 (no later data being published): Capital stock, 9,742,606,000 marks, or 2,594,000 marks per kilo.; revenues from passenger traffic, 274,384,000 marks, or 26 per cent. of total railroad revenues; from goods traffic, 670,525,000 marks, or 71 per cent. Working expenses, 574.795,000 marks, or 15,300 marks per kilo. of existing lines; surplus revenues, 423,898,000 marks, or per kilo. of existing lines, 11,600 marks, or per kilo. of operating lines, 1,630 marks; Rolling stock, 12,532 locomotives, 22,873 passenger cars, 253,933 freight cars.

London Water Companies' Dividends.

The closer anyone looks into the financial constitution of the Metropolitan water companies, the more convinced will he be of the inconvenience arising from their lack of uniformity in regard to capitalization and the distribution of dividends. Nowadays, it is true, Parliament keeps a watchful eye upon the provisions of the special Acts which are from time to time obtained by the companies; but no amount of modern vigilance can remove the effects of the laxity which prevailed in by-gone years. The West Middlesex Co. can boast of an Act passed in 1806, when it was provided, on the incorporation of the company, that the subscribers should "be entitled to and receive the entire and net distribution of an equal proportionate part" of the profits, according to the amounts of their several contributions. This method of distribution was continued when, in 1810, and again in 1813, enlarged powers were conferred upon the company.

Even in 1852, when the most important of this company's special Acts was obtained, no express provision was made as to dividends. The capital was then fixed at £506,300, divided into 8,300 shares of £61 each. Eight years later power was taken to raise further capital to the extent of £180,000, either on mortgage or by the issue of new shares, preferential or otherwise. At the same time it was enacted that if in any year the profits were not sufficient to pay the full preferential dividend for such year, the deficiency should not be made good out of the profits of a subsequent year, nor out of any other funds of the company. Capital issued under a subsequent Act, that of 1869, stands upon a different footing. The sum of £300,000, then authorised, might be issued either as ordinary or preferential, and, as regards debenture stock, the Act provided that the company might attach "such fixed and perpetual dividend as they think fit."

Of course, the involved provisions which are to be found in some of these special Acts are to be attributed to the peculiar notions and the grammatical idiosyncracies of dead-and-gone parliamentary agents. Lucidity and uniformity were not the objects which those gentlemen seem to have had in view. The terms of the special Acts obtained by the Grand Junction Co. appear to us to compare favorably with some of those to which we have drawn attention. This company's Act of 1855, enacts in plain phraseology that the prescribed rate of profit shall be as follows: "As regards the sum of £546,000, £10 in the £100 by the year, and as regards the residue of the capital, £7 10s. in the £100 by the year." This is language which whosoever reads can understand, and references to the general law at once become superfluous.

The special Act of 1868, which brought the capital of the Grand Junction Company up to £1,000,000, is no less successful in telling proprietors what their rights are in regard to dividends, and the same may be said of the Act obtained in 1878. It was necessary to introduce certain qualifications, and it was therefore provided that if in any year the net revenue applicable to dividends should be insufficient to pay the full rates previously prescribed, the revenue should be applied in the first place in payment of dividend on all the ordinary paid-up capital up to 7 per cent., next in payment of a further dividend up to 10. per cent. on the ordinary paid-up capital created under the earlier Acts, and the balance in payment of dividend upon ordinary paid-up capital entitled to a higher rate than 7½ per cent.

The Lambeth Company's Acts also are not difficult to understand, and we observe that power was conferred upon the directors to declare interim dividends, so long as they shall not reduce in any way the company's capital. The special Act of 1871 has no direct bearing on the adjustment of capital or the distribution of profits. It now only remains to refer to the financial foundations of the Chelsea Company. The capital and stock of this undertaking are mainly regulated by the special Act of 1852—that is to say, the general provisions of the Water-Works Clauses Act of 1847 were then incorporated. In 1864, when further powers were acquired, no express reference was made to the general Act as affecting the new capital then to be created; but in 1875 it seems to have been thought expedient to frame the special Act differently, and, accordingly, we find that the provision of the general Act of 1847, with respect to the amount of profit to be received by the proprietors, was then incorporated.

Thus, it will be seen that, in regard to the Chelsea Company, the general law as to the prescribed rate of dividend has been adopted in the Acts of 1852 and 1875: and in the Acts which do not in terms incorporate the general law there are no express regulations as to dividends. It seems to follow, therefore, that the distribution of profits is regulated entirely by the provisions of the Water-Works Clauses Act of 1847. London (England) *Financial News*.

The La Guayra & Caracas Cable Railway.

The National Government of Venezuela has granted to the La Guayra & Caracas Cable Co. an exclusive concession for a cable railroad between the cities of La Guayra and Caracas, which road will pass through the mountains by a tunnel in order to have a direct line. The tunnel is to be of sufficient capacity for all traffic and is to have a roadway for carriages, carts, etc. The company is authorized to collect a fare of 96.5 cts. for each first class passenger and 57.9 cts. for each second class passenger, 9.65 cts. for each foot passenger, 36.6 cts. for each cart drawn by horse or mule, and 19.3 cts. for each animal not attached to a vehicle. Right of way is also granted to and upon the wharf and breakwater at the port of La Guayra, and through certain streets in Caracas.

The land grant gives the public lands for a distance of 1,640 ft. on each side of the line, except within 1,640 ft. of the coast and 164 ft. from rivers. The company has the right to import free of duty all materials and plant required for the construction and operation of the road, and no national, State or municipal tax will be imposed on the property for 99 years; the Government has the right to preference over general traffic in sending troops or war material over the road, paying half rates for such troops and material. Work is to be commenced within nine months from the date of ratification of the concession, March 15, 1888, and is to be completed within three years from the date of commencement. The contract between the government and the company was made in Paris, in December, 1887, by Gen. GUZMAN BLANCO, Venezuelan Minister to Europe, and Mr. T. W. TYRER, attorney for the company; and it was ratified March 15, 1888, by J. C. DECASTRO, Minister of Public Works, at Caracas, Venezuela.

CORRESPONDENCE.

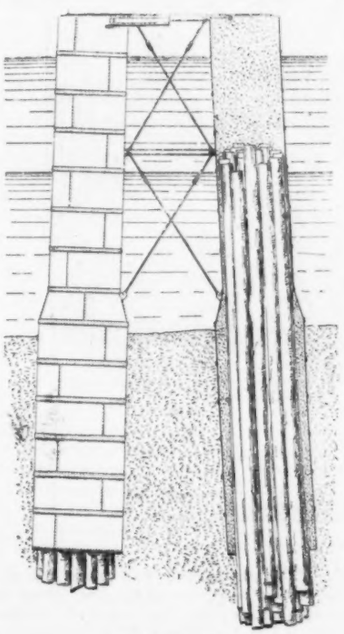
The Petaluma Drawbridge.

California Bridge Co.
SAN FRANCISCO, Aug. 30, 1888.

EDITOR ENGINEERING NEWS:

Noticing the brief account in ENGINEERING NEWS of July 28, of the interesting drawbridge at Petaluma creek, recently designed and constructed by the California Bridge Co., it has occurred to me that an illustration of this bridge might be of interest to your readers, and for this reason I have pleasure in forwarding you a photograph of the bridge and a drawing showing the construction of the center pier. I also enclose cutting from one of our local newspapers giving a brief account of this bridge.

Yours truly, A. D. OTTEWELL.

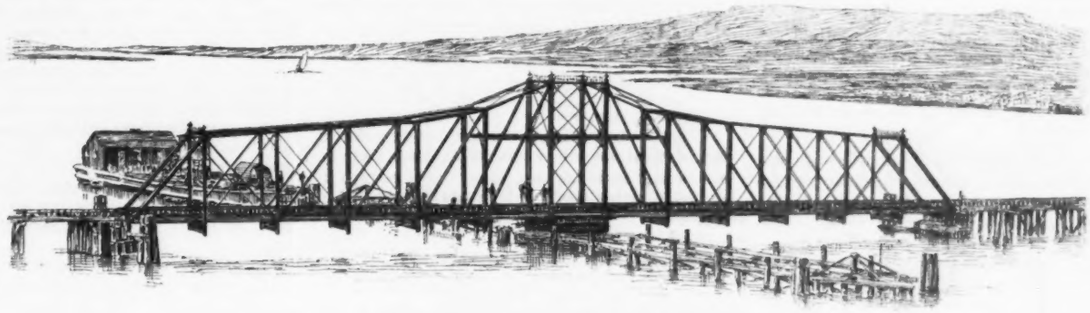


Center Pier: Petaluma Drawbridge.

The cutting referred to is as follows:

The San Francisco & North Pacific Railroad bridge, crossing Petaluma creek on the new Napa and Marin line, is 3,100 ft. long, consisting of 2,874 ft. of wooden trestle work and a drawbridge of steel and iron 226 ft. long, allowing two openings of 100 ft. each.

It is the first steel and iron draw span for railroad use constructed entirely in bridge shops located on the Pacific coast. This was turned out by the California Bridge Company at Oakland, Cal. Satisfactory tests show excellent materials, accurate workmanship, and minimum deflection.



General View; Petaluma Drawbridge.

The substructure afforded an opportunity for originality in design. Petaluma creek, at the point bridged, resolves itself into an arm of San Francisco bay. The great depth and tenacious quality of the mud, gradually hardening with its depth, made any of the ordinary forms of pier construction difficult and costly. A special design was therefore made to meet the unusual conditions.

The pivot pier consists of four clusters of piles. Each cluster, containing nineteen piles varying from 90 to 110 ft. in length, is incased by an iron cylinder 9 ft. in diameter at the bottom, and 7 ft. 6 ins. in diameter at the top. The plates are of boiler iron three-eighths of an inch thick. The cylinders were brought to a solid bearing, after refusing to descend by their own weight by exerting upon them a downward pull of 120 tons, by anchoring to the piles of the cluster. The cylinders are braced together by a system of horizontal struts and diagonal ties. The draw is single track, rim bearing, and is designed for a live load consisting of two 93.5 ton engines (fifty-three tons in 15.75 ft.,—93.5 tons in 61.8 ft.), followed by 2,240 lbs. per lin. ft. The turning gear is such that one man can readily open or close the draw against a stiff breeze in four minutes.

The contractors for, and designers of, the substructure and superstructure of the drawbridge were the California Bridge Company, A. W. BURRELL, President, [and the work was carried out under the direction of F. K. ZOOK, Chief Engineer of the San Francisco & North Pacific Railroad.

Canadian Pacific Locomotive Runs.

Can. Pac. Ry. Co, International Ry. of Maine Section.

EDITOR ENGINEERING NEWS:—

In your interesting article of Sept. 22, descriptive of the Canadian Pacific Railway, I observe that you give a Locomotive Section between Smith's Falls and Toronto as one run of 216 miles. This is not correct This distance is worked by three locomotives as follows: Smith's Falls to Havelock 110 miles, Havelock to Toronto Junction 100 miles, Toronto Junction to Union Station (local engine) 5 miles.

You also give between Quebec and Montreal as one run of 172 miles. I think this likewise is made up of two sections—Quebec to Three Rivers 77 miles, Three Rivers to Montreal 95 miles.

In the longest run for one engine on the C. P. R. —between Port Arthur and Ignace the limit seems to have been reached over which it is wise to make a continuous run for man or "machine."

S. B. MCKEE, *Div. Engr.*

Keeping Notes of Curves.

TOPEKA, Kan., Sept. 30, 1888.

EDITOR ENGINEERING NEWS:

In your issue of 22 inst. Mr. BURGESS, gives a method of keeping curve notes, which is unquestionably the best and most logical, but it has been taught to his classes by Prof. J. B. DAVIS at the University of Michigan for a long time; how long, I cannot say. I learned it of him in 1879-80. In *Remarks* column, he adds the radius of curves, as useful in plotting.

The only trouble I have found with it is in running curves with spiral approaches. The only way out I ever found was in treating each spiral as a separate curve—and making my list of deflections for the portion of the curve only which was regular.

Yours truly, W. W. FOLLETT.

[It is, as a rule, not expedient to run in transition curves by the transit at all, but rather by offsets. When they are run in by the transit, however, the notes must of course be kept separately, as for a curve of an entirely different nature from the circle.—ED. ENG. NEWS].

Office of Asst. Eng., Baltimore & Drum Point R. R.
PRINCE FREDERICK, Md. Sept. 26, 1888.

EDITOR ENGINEERING NEWS:

In reference to the article in ENGINEERING NEWS of Sept. 22, page 233, I herewith enclose a sample of notes as kept by many engineers in running curves. I have never seen this method in any Engineer's Field Book, but for convenience and simplicity, I think it is one of the best methods in use, the vernier always reading zero on tangent.

Sta.	Def.	T'l'deflection	Total An'le	D'd'c'd course.	N'dle cu'se	Remarks.
+ 40 P T.	.0°00'	33° 22½'	66° 45'			
11	7°30'					
10	3°45'					
9	.15°00'	24° 22½'				
8	11°15'					P. T. Sct.
7	7°30'					I = 66° 45'
6	3°45'					I = 503.3'
5	.0°22½	9° 22½'				R = 764.5'
4	5°37½					curve = 800'
3	1°52½					
2+50 P. C.	7°50' R					

Almost always at the P. C. or first deflection you have odd minutes or fractions of a minute, which is disposed of at the first turning point. At any turning point on the curve your vernier is at zero when the telescope is in tangent, making the vernier readings more simple and lessening the liability to commit errors in turning and reading the vernier; you have as many checks on the total angle as in any other method. By subtracting the deflection for any station or plus from the one above it you have the deflection for the distance between those points, all of which is apparent by a glance at the notes herewith. I do not see the advantage of spending time to calculate all the deflections before starting on the curve. In timber and hilly ground you cannot tell at what station or plus your turning plugs will come. Any good transitman can calculate his deflection while the last stake turned for is being driven and measurement taken for the next,

Yours truly G. W. CUNARD, R. E.

[If our correspondent will carefully consider the whole matter, we think he will see reason to change his opinion. The method he gives is that given in both HENCK's and SEARLES' pocket-books, and even that of SHUNK's is in our judgment an improvement upon it.—ED. ENG. NEWS]

A Question as to Pump Wells.

EDITOR ENGINEERING NEWS:

In constructing a dry well, say 30 ft. in diameter and 50 ft. deep, in which to place pumps, where the water is liable to rise around it 45 or 50 ft., and

whose bottom is slate with a dip of 45°, full of seams through which water rises, would good practice sanction giving any less weight to the masonry of sides and bottom than the weight of water displaced by the well and its masonry?

If it is prudent to trust to the friction of earth against the wall to counteract the buoyant effort of the water, what would be deemed a safe allowance? In a concrete bottom laid as an invert, what would be a safe load to expect it to stand?

The writer thinks the masonry of bottom and sides should exceed the weight of water displaced; but would very much wish to be sat down on if holding an erroneous opinion. Can you enlighten him or have it done through your column of questions and answers?

[As the specific gravity of concrete is only 2, the one thing which should certainly not be done is to fill a 50 ft. well half full of concrete to resist the pressure by weight alone. Precisely what should be done depends largely on the nature of the surrounding material.—ED. ENG. NEWS.]

Keeping Notes of Curves.

MILWAUKEE, Wis., Oct. 3, 1888

EDITOR ENGINEERING NEWS:

The method of keeping transit field notes recommended in a recent number of your journal by Mr. ROBERT BURGESS, is very much the same as that advocated in a paper written by the undersigned, and read before the Boston Society of Civil Engineers, April 18, 1883. (See Journal of the Association of Engineering Societies, Volume 2, Page 147.)

The difference is in this, that the writer makes the reading for full stations even degrees, having odd minutes only at the plus stations. As there are usually more full stations to set than plus stations, it takes less time to set the vernier to full or half degrees than to odd minutes. The odd minutes and the odd distances occur together, thus aiding the transit man in keeping his wits together. Still this is a matter of detail that different individuals would view in different lights. The great point is to write out a complete table of vernier readings before commencing to run in the curve: then, when once correctly written out, the vernier readings can be used in running the curve at any time thereafter. Whether it is run forwards from the P. C. or backwards from the P. T. or run both ways from the middle, in all these cases the table of vernier readings is correct and convenient. Yours truly,

T. APPLETON.

[We presume the method referred to is to make a certain constant addition to all the readings, so that instead of being fractional, as the true readings are in the first column below, a certain conventional addition to all the readings is made to bring even readings at even stations, as in the second column below:

	True Readings.	Conventional Readings.
4	3.49½	4°
3	2.19½	2° 30′
2	0.49½	1°
1+45 P. C. 3° R.	0°.0′	0°10½′

There is something to be said for this, but it is of advantage only when the curve is an even one, and it seems to us on the whole inexpedient, although the result is identical.—ED. ENG. NEWS.].

Novel Type of Falseworks.

PORTLAND, ORE., Aug. 18, 1888.

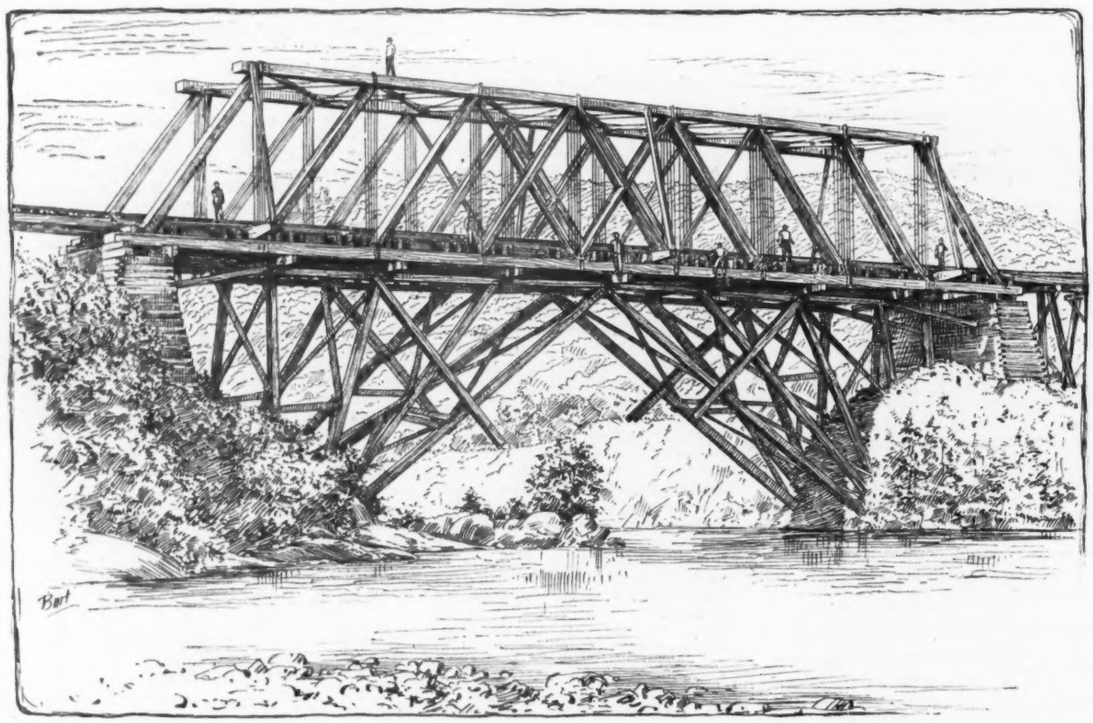
EDITOR ENGINEERING NEWS:

I enclose herewith a photograph of the Rogue River Truss on the Oregon & California Railroad in Southern Oregon, showing bridge as it is swung off of falsework. I think the falsework here a rather exceptional one which might be of interest to you. The old truss was a 14 panel 150 ft. Howe and was to be replaced by a 9 panel Howe, of same length. The water being of about 40 ft. depth and the uncertainty of getting firm footing on the irregular rocky bottom, the falsework as shown was decided upon. The abutments of the falsework are 94 ft. centers, the braces spanning the channel are 14′. ×14″×64′ and 14″×14″×58′. All other braces and posts are 14″×14″, caps 12″×12″, girts 10″×12″ and sway braces 3″=10″ single or double. The bridge carpenters as well as the train men were afraid of this falsework, and predictions of disaster were made. The photograph was taken just as their cause for fear was over and the new bridge capable of sustaining its load. The truss will be enclosed and painted, and we hope will last for 25 or 30 years.

Respectfully Yours,

W. A. GRONDALL.

Asst. Engr., O. & C. R. R



Novel Type of Falseworks; Oregon & California Railroad.

Determining "Center of Mass" of Earthwork.

KANSAS CITY, Mo., Sept. 29, 1888.

EDITOR ENGINEERING NEWS:—

Referring to the inquiry on p. 228 of a correspondent, as to the best method of obtaining "center of mass" in calculations of haul, I would say that the following was the way referred to in my communication from Pittsburg in 1882: The cubic yards between consecutive cross-sections, having been calculated and noted as usual, the center of mass of any cut or fill is easily found by the addition of the various amounts until a sum is reached equal to half the total cut or fill, at which point we may assume the center of mass. In a similar way the center of mass of any portion of an embankment or excavation may be found. This may be done as roughly or exactly as occasion requires and has been found a rapid and simple method. In heavy work, or whevever it is necessary to allow for the extent of "free haul", the equal amounts in cut and fill, to the "limit of free haul" can be determined tentatively, and the summation for the center of mass begun from said limits.

The practice of paying "both ways" and disregarding the question of haul is without doubt, in the greater part of railroad work, the simpler and better way.

ALPHA.

Keeping Notes of Curves.

SCRANTON, Pa. Oct. 2, 1888.

EDITOR ENGINEERING NEWS:

I think you have set going a very excellent work by publishing the letters which have lately appeared in your journal concerning the keeping of transit notes. The importance of well kept, systematic notes of a survey or location, is much more apt to be under than overrated, until perhaps after a long campaign of field work, they get into the office, and the draughtsman finds inconsistencies which he has no means of reconciling.

I have in the course of a long field practice, found the utility of observing certain precautions in keeping transit notes which it is the object of this letter to suggest to others. Probably they may be already known to many, though I have never seen them mentioned in any field book, and do not know of any engineer using them, excepting the members of my own corps, among whom I introduced this method some ten years ago, when making surveys for the Bronx River water supply for the city of New York

As respects the method of keeping curve notes, developed in your last two issues, it seems to me to be an excellent one, and I can see only one possible objection to or rather one very slight difficulty in its use. That is, as in "moving up" it would almost invariably happen that the plug fell between even stations, it would become necessary to interline the changing point, and the method would so far fail, in that the entire system of deflections could not be written out in advance. As paper is cheap, it would probably be better to write the stations and corresponding deflections on alternate lines of the page, leaving thus plenty of room for interlineations.

One other point: There is this objection to any routine system, that one is apt to lose sight of the underlying principle, and to be unable to recall it, when, on an emergency the system fails to cover the ground, and it becomes necessary to know just where you are and what you are doing, so as to be able to tell what to do next. It seems to me that nearly all emergencies in curve running are met by getting the line of collimation on the tangent to the curve at the point where the instrument is set up. You are then master of the situation, and can continue, compound, or reverse your curve, or cut loose from it altogether at pleasure. Therefore, no system, however useful, should ever betray the transitman into even temporary forgetfulness of the grand fact, that you always get on the tangent by sighting back to the station just left (or any other station), and turning off the angle which got you or would get you from that station to the one you are set up over.

It seems to me that it would be an excellent scheme, when the instrument was set up at the point of intersection, after deciding upon one's degree of curve, to turn off the external secant, and set a plug in the middle of the curve, to check upon when one gets so far along with it. Perhaps this course is pursued by some engineers, but I do not recall hearing or reading of its use, as a check.

But to come to the method of which I wish to speak. Suppose the left hand page of the transit book to be ruled in 8 columns, headed as follows:—

Station	Distance	Left	Right	Supplement	Magnetic course	Back sight	Calculated course

I am supposing that the notes are kept commencing at the bottom of the page and running up, which, among other advantages, facilitates sketching on the right hand page.

The first two headings require no explanation. The deflection angles are noted in separate columns for a reason shortly to be mentioned, and they are recorded in their natural positions, looking along the line from the transit. The next column contains the supplement of the deflection angle (when the limb is graduated from 0 to 180°, as is commonly the case), and the proper entry is obtained by reading the second vernier. This is the important feature, as far as the field work goes, of the method I am describing, and I wish to strongly impress the great importance of never recording the deflection angle without reading and recording its supplement from the other vernier. By adding the two together, mentally or on paper, and seeing if their sum equals 180°, *a mistake in reading the vernier is rendered impossible.* The only mistake of record that can be made, would be in entering the angle in the wrong column, left for right, or *vice versa.* This can generally be checked by the magnetic course, unless the angle is very small and there is more or less of local attraction. To guard against this is the object of the column headed "Back-sight," in which is recorded the magnetic bearing of the back sight. Besides this, the transit man should always notice which way his vernier reads at each angle, as this will determine with certainty whether he has deflected to the right or left. The column headed "Calculated course" should be filled in each evening after coming in from work.

If the above method is pursued, and if, after recording all the observations, the vernier is turned back to zero (as you have suggested) and the back sight looked for, it may be said with certainty that no error can be made in the field work which will not be instantly detected.

The deflection angles are entered in separate columns, added up, and their difference carried forward from the first course to the last. By doing this, an absolute check is obtained for the calculated courses, for at any given station the balance of the deflections applied to the bearing of the first course should give the same calculated course as that obtained by successively calculating each separately.

In the same manner, the distance should be regularly footed up and carried forward, and at any given station their sum should equal the number of that station.

All this may seem like a good deal of work, but in reality it takes but little time either in the field or the office, which is a thousand fold repaid by the feeling of certainty that your notes are all right.

I have shown in the above table, all the entries as being made on one page. In point of fact, as transit books are ruled to only six columns on the left hand page, two of the headings shown must be placed over on the right hand page. One of these—the bearing of the back sight—will generally be dropped, although with an inexperienced transitman it is always best to retain it, and the most convenient item to place on the next page is the supplement of the angle.

I have had a large series of field notes taken in this way, and the results were very satisfactory.

G.

[We give space to this communication without approval of some of its suggestions. No error in distance is possible if stakes are marked consecutively in advance. Setting the P. I. is the exception in practical location and if set, the utility of fixing the central point of the curve from it depends upon how often the transitman finds he has practical need of it when he has run in the whole curve. It should be rarely.—ED. ENG. NEWS.]

Tests of Coil Boilers.

Navy Depart., Bureau of Steam Engineering.
WASHINGTON, D. C., Oct. 4. 1888.

EDITOR ENGINEERING NEWS:

In reply to your letter of the 15 ult., I give below an abstract of bids for coil boilers for a coast defense vessel of the navy, which were opened on 1st inst.

In this case the amount of the bids is of secondary consideration, the competition being on the merits of the boiler, which will be tested in accordance with the terms of the enclosed circular. It was thought advisable to require bids to be submitted with plans in order to prevent any fancy prices being made after the best boiler is selected by competitive test.

Plans submitted by	Total grate surf. sq. ft.	Total heat. surf. sq. ft.	Bids.
Wm. Cowles, 45 Broadway, N. Y.	212	7820	$23,800
" " "	212	8456	25,800
Chas. Ward, Charleston, W. Va.	212	8036	20,960
Frank B. King, Washington, D.C.	176	8824	26,000
Hohenstein Mfg. Co., Newark, N. J.	208	14400	†60,000
F. C. & A. E. Rowland, N. Haven, Ct. (representing the Belleville Boiler)	300	10010	No bid.*
John Svedberg, Washington, D. C.	200	7377	No bid.
D. Davis, Crumlin, Monmouthshire, Eng.			General plans.
Union Iron Works, San Francisco, Cal. (representing E. J. Moore, water tube boiler)			General plans.

Very respectfully GEO. H. MELVILLE,
Engineer-in-Chief, U. S. N., Chief of Bureau.

The specifications for tests are as follows:

On or before Oct. 1, 1888, persons who wish to offer boilers in competition will furnish outline plans showing the boilers in place in the vessel for which they are intended—a blue-print of the boiler compartments of which vessel accompanies this circular.

The coil or sectional boilers must be designed to furnish continuously, under forced draft, with due economy, at least three-fourths of the steam necessary to work triple expansion engines of 4,800 I. H. P., at 160 lbs gauge pressure.

The boilers must be divided equally between the two boiler compartments. They will work in connection with the two cylindrical return-fire-tube marine boilers shown on the blue-print.

†Erected on board ship.

*All Belleville Boilers, discarding the two Scotch boilers used in connection with the other plans.

There must be noted on the plans submitted the following information:

Area of grate surface. Area of heating surface. Weight of boilers and fittings. Weight of uptakes and boiler seatings. Weight of water in boilers. Center of gravity of boilers, etc., in steaming condition. Proposed rate of combustion. Proposed rate of evaporation per pound of coal from and at 212° F. Total evaporation per hour from feed water at 120° F. to steam of 160 lbs. gauge pressure which will be guaranteed. Percentage of dryness of steam which will be guaranteed.

There must also be a drawing of one boiler in sufficient detail to permit of its construction being understood.

Persons submitting plans must, in order to have them considered, submit also sealed proposals for furnishing the boilers at the New York Navy Yard within six months after receipt of an order for the same, including all fittings, complete and ready to be erected on board ship, and to receive steam, water and air connections. These bids must be accompanied by specifications stating just what is proposed to be furnished. These bids will be opened in the presence of competitors on Oct. 1, 1888.

After an examination of the plans, those which appear feasible will be selected, and the persons offering them so notified. Such competitors as then wish to offer their boilers for test will be required to do so within three months from date of notice. The boilers offered for test must be of the type and approximately of the same size as those shown in the submitted plans and intended for the vessel. They must be fitted up complete for test at competitor's expense. For each boiler two tanks must be supplied, each of sufficient size to hold feed-water for at least 15 minutes' steaming—one for a measuring-tank and the other to feed from. Also, an accurate platform-scale, with a tank of about 50 galls. capacity, for calorimetric tests. Also, a platform-scale for weighing coal. All testing instruments will be provided by the Navy Department.

An evaporate test, of not less than 24 hours' duration using clean fresh water, will be made at the rate of combustion proposed to be used on board the vessel, all feed-water being measured, coal weighed and steam tested for dryness. Steam will be kept at 160 lbs. pressure in the boiler and will be blown off at the stop-valve.

Boilers which give good results in evaporation will be further tried by being surrounded by walls (rough boards will be sufficient), representing the adjacent bulkheads on board ship, and, thus limited in room, the various joints of the boiler will be made and unmade, tubes or coils taken out and put in, etc., etc., to prove that repairs can be properly made in the space available.

Satisfactory proof must be made that the boilers can be worked together in battery and in connection with ordinary marine boilers.

The boiler which, after the above specified tests, may be selected as the best for the purpose intended, will, if considered necessary, be further subjected to a test to show whether or not it will work satisfactorily under the every-day conditions existing on board ship, with such feed-water as is obtainable after continued steaming, charged with grease, etc., from the engines.

Sufficient means must be provided for thoroughly cleaning the heating surfaces when using dirty coal.

The boilers made for use on board ship must be of domestic manufacture.

Either New river or George's creek bituminous or anthracite coal will be used in the tests.

LONG CANALS OF THE WORLD.—An English exchange gives the following list of long canals: The Imperial canal of China is over 1,000 miles long. In the year 1861 was completed the greatest undertaking of the kind on the European continent, the Canal of Languedoc, or the Canal du Midi, to connect the Atlantic with the Mediterranean. Its length is 148 miles, it has more than 100 locks and about 50 aqueducts, and its highest part is no less than 600 feet above the sea, while it is navigable for vessels of upwards of 100 tons. The largest ship canal in Europe is the great North Holland canal, completed in 1825. It is 125 ft. wide at the water surface, 31 ft. wide at the bottom, and has a depth of 20 ft., and extends from Amsterdam to the Helder, 51 miles. The Caledonian canal, in Scotland, has a total length of 60 miles, including three lakes. The Suez canal is 88 miles long, of which 66 miles are actual canal. The Erie canal is 350¼ miles long; the Ohio canal, Cleveland to Portsmouth, 332; the Miami and Erie, Cincinnati to Toledo, 291, and the Wabash and Erie, Evansville to the Ohio line, 374.

THE new United States gunboat *Petrel* is to be launched on Oct. 13, at the Columbia Iron Works, Baltimore. She is 175 ft. long, 31 ft. broad and has a mean draught of about 12 ft. She will be supplied with engines and boilers developing with forced draught about 1,350 H. P.

ENGINEERING NEWS

AND AMERICAN RAILWAY JOURNAL

Published Weekly at Tribune Building, New York.

VOL. XX. Saturday, October 13, 1888.

D. McN. STAUFFER, A. M. WELLINGTON. EDITORS.

GEO. H. FROST. - - - - - BUSINESS MANAGER.

Subscription. — UNITED STATES AND CANADA, $5.00 *per Year;* $2.50 *for Six Months;* $1.50 *for Three Months; Single Copies,* 12 *cents.* FOREIGN COUNTRIES, $6.56 *per Year, or* 3 *cents per number additional.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also,* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

Coming Technical Meetings.

American Society of Mechanical Engineers.—Convention and annual meeting at Scranton, Pa.; beginning Oct. 15. Secy., F. R. Hutton, 280 Broadway, New York.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, Oct. 16. Secy., S. M. Wickersham, Penn Building.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, Oct 17.. Secy., S. E. Tinkham, City Hall.

American Society of Civil Engineers, New York.—Regular meeting, Oct. 17. Secy., John Bogart, 127 E. 23d St.

American Street Railway Association.—Next meeting at Washington, D. C.; Oct. 17. Secy., W. J. Richardson, Brooklyn, N. Y.

OUT of over 500 old water-works in the New England States, New York, New Jersey and Delaware, we have received reports from all but three.

Out of about 170 old water-works in Pennsylvania, we still lack *sixteen.* We do not attempt to explain this not very creditable contrast, but we shall be greatly obliged if any of our subscribers who can, will aid us in obtaining reports from the following works in Pennsylvania from which we still lack information:

Bethelehem	*Media*	*Stroudsburg*
Centralia	*Petrolia*	*Summit Hill*
Dunmore	*Pottstown*	*Tamaqua*
Langhorne	*Reading*	*Waynesboro.*
Lansdale	*Renovo*	
Manheim	*Scranton*	

We also lack reports from Frederick, Md., and from New York Mills, Tarrytown and Thousand Island Park, New York. The South and West have generally responded promptly, and Pennsylvania has so far been much the most remiss of any State.

WE are compelled by the pressure on our space to postpone the presentation of the report of the Board of Experts on the Quaker Bridge dam. The report in general is an excellent one, although there are certain parts of it which we think are open to question; and the main conclusions are certainly admirable, viz., that the upper part of the section should be materially thickened, and changed into a sweeping curve instead of a series of broken lines, and that the plan should be changed to a curve with the axis of the dam further up stream. The Board recommend a very decided change in location, throwing the east end some 650 ft. up stream, and so lengthening the crest from 1,403 ft. to 1,693 ft. They also, on theoretical grounds which we are compelled to regard as fallacious, increase the normal cross-section from 26,509 to 27,481 sq. ft., a difference of 3.53 per cent. Nevertheless the comparative cost of the two dams is $3,824,754, and $4,171,380, a difference of only 8.28 per cent. and the volume of masonry is only increased 7.57 per cent. The location proposed has much to recommend it, especially the fact on which the Board with much reason lay stress, that although the crest is much longer, the deep rock basin underlying the present surface, to which the dam must be carried down, is much narrower, decreasing by so much the chance for heavy unforeseen expenses in that troublesome part of the work.

RAILWAY accidents of serious moment have been singularly few this year, and it is at least a striking coincidence that after an interval of 14 months and a day from the last great disaster at Chatsworth, Ill., there should be another excursion train accident to illustrate the very exceptional dangers which beset special trains. There are no available statistics to show precisely how much more dangerous such trains are, but the passenger on them has at the very least 20 times the chance of coming to grief that he has on a regular train, and it is more likely, 40 or 50 times as great a chance; for the number of such trains is relatively extremely small, while the number of accidents to them is extremely large.

There is another singular fact about this accident. Early in last year there were three accidents in quick succession, the White river, Bussey bridge and Chatsworth, all of which were due to defects of engineering practice, and all but one of which were the most serious since the Ashtabula disaster, 11 years before. Since that date there has not been a single first class catastrophe until this one, which appears to have been more fatal than two at least of those of last year, but which seems to have been entirely due to operating carelessness, the record of disasters due to engineering defects since last year having been gratifyingly small. It seems strange that in a case so evidently calling for exceptional caution as the despatching of eight heavily loaded special trains in quick succession so little should have been used, but the Lehigh Valley has been fortunate for many years in respect to accidents, and it would seem as if nothing but occasional slaughters were effectual in leading men to be duly careful either in handling trains or designing structures and plant.

THERE is one statement in the paper by Mr. L. Y. SCHERMERHORN on the great lakes, from which we printed an extract in our last issue, which brings out their enormous volume in a new and striking way. Were all access of water to the lakes cut off, and the entire discharging capacity of Niagara river and falls concentrated on the single task of emptying the four great lakes above it, it would take *one hundred years* to discharge all the water contained in them over the falls, assuming the present rate of flow to continue and the falls to be able to discharge the entire volume of each, which would of course be out of the question, since all the lakes but Lake Erie, which is remarkably shallow by comparison, extend far below the level of the sea.

It is quite impossible to comprehend a volume so vast as these figures imply, but it helps one to realize how vast are the inland seas, which, we cannot but feel, are as yet only imperfectly utilized because of lack of suitable access to them from the sea. By one channel at least this is possible, a canalization on a grand scale of the Ottawa river, which offers singular facilities for the work, so as to afford direct access to the lakes for ocean vessels of 26 to 28 ft. draft, with but few locks of heavy lift, built in the solid rock which lines both sides of that river for most of its length, enabling the whole to be slack-watered by dams with hardly any canal excavation proper, and with but a moderate amount of excavation under water to deepen the channel, for a work of such vast and continental importance. It would be cheap indeed at a total cost of $50,000,000, (which is much more than it need cost) since it would afford a route 400 miles shorter than *via* the St. Lawrence and Niagara, as well as one vastly superior in other respects.

THE project of canalizing the Ottawa for "grand navigation" has attracted singularly little attention for one of such great promise, and one reason why it should do so is evident. The route lies exclusively in Canadian territory, and hence is not one which comes within the scope of the American Government and people, while the ports to be benefited are wholly American, the Canadians having not a single town of any importance on the four upper lakes, and thus the project is not one to attract Canadian enterprise. But its effect would be, if properly carried out, to transform Duluth, Milwaukee, Chicago, Detroit, Toledo, Cleveland and even Buffalo into ports open to ocean vessels of all but the very largest class, and hence could not fail to exercise an immense influence on the development of the interior of the Continent. Had the route lain within our own territory, it would have been canalized long since, and were Canada a part of the United States, it would not be six months before a powerful agitation would begin in favor of the work, which is pre-eminently one for Governmental enterprise; but as it is, it is hardly to be wondered at that the project attracts so little attention on either side of the line that few people know such a possibility exists. A survey for a light draft canal was made by Canada in 1860, and showed that the route could be canalized for 12 ft. draft for $12,057,680, but such a canalization would be of no great use, and it is fortunate that the project in that form was not carried out.

THE present St. Lawrence and Welland canals are mere child's play in comparison with modern requirements, however useful in their day and creditable to Canadian enterprise. And the obstacle to any more radical and adequate improvement of the route is pithily expressed in the answer to the old conundrum why no one builds mills on the Mississippi, "dam it you can't". The St. Lawrence is just such another stream, while the Ottawa can be very easily and cheaply dammed by simple rock fills, there being such an ample flow of water that tightness in a dam is of slight importance. The importance of having a great depth of draft in any ship canal which is to be useful to modern commerce, is well illustrated by the history of the Sault Ste. Marie canal. It was opened only in 1855, the Welland and St. Lawrence canals long antedating it. It was in a wild and unsettled region, whereas the Canadian canals are in the very track of the commerce of the continent. It serves the commerce of only one lake, whereas the Welland purports to serve four; yet the commerce of the Sault has grown within 33 years (and chiefly within 10 years) to the enormous proportions we chronicled last week, by far the largest of any canal in the world, while the traffic of the Welland is still a picayune affair. In part this is owing to the disadvantage which the Welland labors under of being in a foreign country, which no doubt repels a great deal of traffic from it, but in larger part it is simply because it is too small for ocean commerce to pass through.

The Water-Works of New England.

Our forthcoming *Manual of American Water-Works* has advanced so far that we are now able to begin the presentation of the first and only complete summary of the status of water-works construction in this country which has ever appeared. Three times before we have published "Statistical Tables of American Water-Works" which were compiled for us by Mr. J. J. R. CROES of this city; but without more trouble than then appeared expedient, it was impossible to make the tables so nearly complete as to make it advantageous to summarize them by States and sections, to show by aggregates the actual status and tendency of water-works construction.

This difficulty we have at last overcome, however, in the compilation of the *Manual* soon to appear, whose completeness can be in part understood from the accompanying tabular records, summarizing every important fact of a general nature in regard to the water-works of the New England States. This summary will be followed by others for the successive groups of States into which we have divided the Union (following the grouping of Poor's *Railroad Manual*) and for the Dominion of Canada. The aggregates will bear surprising testimony to how vast an interest water-works have become, and largely within the last few years.

The water-works of New England (and of the United States as well, so far as we know) began where so much else that is good has begun, in Boston, Mass., in 1652, where a reservoir 12 ft. square near the present Dock Square was supplied by pipes from neighboring springs, and used for fire and domestic purposes. In 1796 an "Aqueduct Corporation", with a capital of $30,000 supplied the

TABLE I.

NEW ENGLAND WATER-WORKS.—SUMMARY OF DATES OF CONSTRUCTION

[Date of completion taken when construction extended over more than one year.]

YEAR.	Water Works Built.			YEAR.	Water-Works Built.		
	Main.	Subsidiary.	Total.		Main.	Subs.	Total.
Before 1800	1	0	1				
1800-10	2	0	2	1871	2	1	3
1811-20	2	0	2	1872	7	0	7
1821-30	1	0	1	1873	14	0	14
1831-40	3	0	3	1874	7	0	7
1841-50	3	0	3	1875	8	0	8
1851	1	0	1	1876	10	1	11
1852	1	0	1	1877	3	0	3
1853	0	0	0	1878	6	1	7
1854	2	1	3	1879	8	1	9
1855	4	0	4	1880	6	1	7
1856	1	0	1	1881	8	1	9
1857	2	0	2	1882	9	3	12
1858	0	0	0	1883	9	1	10
1859	1	0	1	1884	21	1	22
1860	2	1	3	1885	16	3	19
1861	1	0	1	1886	16	2	18
1862	3	0	3	1887	24	6	30
1863	0	0	0	1888	20	2	22
1864	1	0	1	Unknown.	8	0	8
1865	1	0	1	Total.	254	32	286
1866	1	0	1				
1867	2	1	3				
1868	4	1	5				
1869	9	1	10				
1870	4	3	7				

Subsidiary water-works are those which derive their supply from the mains of some other adjacent works, but are otherwise independent systems.

TABLE II.

NEW ENGLAND WATER-WORKS.—SUMMARY OF CONSTRUCTION BY STATES AND HALF DECADES.

[Subsidiary Water-Works are indicated by numerals in parentheses.]

DATE.	Water-Works Built in						Total.	Grand Total.
	Maine.	N. H.	Ver't.	Mass.	R. I.	Conn.		
Before 1800	..	1	..	0	..	..	1	1
1800-10	..	1	..	1	..	..	2	2
1811-20	..	1	1	0	..	..	2	2
1821-30	..	1	..	0	..	..	1	1
1831-40	..	1	..	1	..	1	3	3
1841-50	..	..	2	1	..	..	3	3
1851-55	1	1	1	(1) 4	..	1	(1) 8	9
1856-60	..	..	1	1	..	(1) 4	(1) 6	7
1861 65	..	..	..	3	..	3	6	6
1866 70	(3) 2	1	2	(3) 9	..	6	(6) 20	29
1871-75	2	4	2	(1) 25	..	5	(1) 38	39
1876 80	(1) 4	..	6	(2) 14	(1) 3	6	(4) 33	38
1881 85	7	(1) 4	3	(6) 39	(2) 2	8	(9) 63	72
1886-88	(6) 16	14	4	(1) 21	(2) 6	(1) 7	(10) 68	78
Total	(10) 32	(1) 29	22	(14) 119	(5) 11	(2) 41	(32) 254	286

TABLE 5.

NEW ENGLAND WATER-WORKS—SUMMARY BY DATES OF FIRST CONSTRUCTION OF THE MAIN STATISTICS OF ALL NEW ENGLAND WATER-WORKS, AS GIVEN IN TABLE III.

Date.	Present Pop'n on Water-Works.	No. of Works.			Present Finances.		Miles of Mains.	Number of		
		Main.	Subsidiary.	Total.	Cost.	Revenue		Taps.	Hyd'ts	Meters
1798 1850	420.731	13	0	13	20,278,983	$1,362,443	591-23	60,336	5,419	3,159
1851-60	271,726	14	2	16	8,770,696	774,467	634-30	40,572	2,509	7,501
1861-70	432,767	26	6	32	11,878,577	1,340,755	953-11	67,488	5,257	1,655
1871-80	741 211	71	5	76	30,739 014	2,06[illegible],290	1,778-33	104,125	11,297	22,052
1881-85	329,681	63	9	72	7,217,407	476,733	736-30	32,846	4,810	2,860
1886-88	213,243	68	10	78	6,108,048	397,936	575-43	11,037	2,918	695
Total	2,409,359	255	32	287	$84,992,725	6,412,624	5,290-70	315,404	32,300	37,913

N. B.—This table does not represent the status of the works at the several dates (except as to number) but the statistics for the *current year* of works first opened at the several dates.

TABLE 3.

MAIN DETAILS OF THE WATER-WORKS OF NEW ENGLAND BY STATES.

Summarized according to Date of Original Construction, showing the Present Condition of works started in each Decennial or Quinquennial Period.

[N. B. the figures opposite each date must not be taken as representing the condition of the works at that date, but merely as the *present condition* of works then existing.]

MAINE.

DATE.	Present Pop'n Suppl'd.	No. of Works.			Present Finances.		Miles of Mains.	Number of		
		Independent.	Subsidiary.	T'tal	Cost.	Rev.		Taps.	Hdr'ts	M'ters.
1851-60	15,002	1	0	1	$500,000	$40,000	80-00	1,200	112	0
1861-70	50,468	2	3	5	1,780,009	242,000	121-00	7,435	336	164
1871-80	53,825	6	1	7	1,321,940	137,481	95-90	6,323	411	75
1881-85	31,577	7	0	7	435,000	41,367	48.50	2 151	243	12
1886-88	57,647	16	6	22	2,410,000	227,052	160-55	3,540	642	272
Total.	208,717	32	10	42	6,416,940	687,903	505-95	20,639	1,744	473

NEW HAMPSHIRE.

1798-50	22,820	5	0	5	$85,500	$18,200	30-50	735	23	25
1851-60	18,397	1	0	1	250,000	27,500	35.00	2,500	75	25
1861-70	6,784	1	0	1	211,096	12,917	30.00	1,187	136	0
1871-80	52,896	4	0	4	1,400,876	81,498	118.63	5,515	559	776
1881-85	16,586	4	1	5	323,000	17,976	33.05	1,100	184	13
1886-88	28,356	14	0	14	644,500	17,775	80-03	727	333	19
Total.	134,839	29	1	30	2,914,972	178,860	327-21	11,764	1,312	858

VERMONT.

1820 50	6 582	4	0	4	$136,000	$14,600	22-43	1,066	104	10
1851-60	8.815	2	0	2	136,000	17,876	20-60	1,130	60	0
1861 70	13,147	2	0	2	399,351	33,560	35-88	2,540	195	374
1871 80	20,601	8	0	8	412,000	24,532	58-50	2,473	253	2
1881-85	6,980	3	0	3	162,000	4,100	12-50	325	22	0
1886 88	11.405	4	0	4	146,000	7,300	27.00	400	83	3
Total.	67,530	22	0	22	1,391 351	101,962	176-01	7,934	717	389

MASSACHUSETTS.

					$	$				
1801-50	390,339	3	0	3	20,052.483	1,329,143	536.50	59,535	5,292	3,115
1851-60	134,831	5	1	6	4.772,358	390,676	285-30	21.077	1,751	7,095
1861-70	218,542	12	3	15	5.819,196	657,788	469-03	41,089	2,675	759
1871-80	437.728	39	3	42	18,400,061	1,230,273	1043.70	62,599	7,320	10,600
1881 85	220,186	39	6	45	5,186,736	341 383	535.40	24,907	3,456	2,144
1886-88	69,415	21	1	22	1.810,548	96,019	202-85	4,389	1 344	251
Total.	1,471,041	119	14	133	56,041,382	4 045,282	3072-78	213,596	21,838	23 964

RHODE ISLAND.

1876-80	144,636	3	1	4	$8.271,330	$517,449	350-00	20,423	2,276	10,535
1881-85	39,850	2	2	4	619,871	41,403	55-35	2,135	614	679
1886-88	13,778	6	2	8	539.500	17,230	38-00	615	198	127
Total.	198,264	11	5	16	9,430,701	576,082	443.35	23.183	3,088	11,341

CONNECTICUT.

1832-50	999	1	0	1	$5,000	$506	1-80	——	——	
1851-60	99,681	5	1	6	3.112,338	298,424	214-00	14,665	601	381
1861-70	143,828	9	0	9	3.698,934	394,490	297-50	15,247	1,913	358
1871-80	31,525	11	0	11	932,807	66,054	111-60	4,792	478	64
1881-85	20,502	8	0	8	490,800	30,510	73-50	2,228	291	14
1886-88	32,642	7	1	8	557,500	32,560	67-00	1,356	318	73
Total.	329,163	41	2	43	8,797,379	822,535	765-40	38,288	3,601	888

TABLE 4.

NEW ENGLAND WATER-WORKS—SUMMARY BY STATES OF THE MAIN STATISTICS GIVEN IN TABLE 3.

State.	Present Pop'n on Water-Works.	No. of Works.			Present Finances.		Miles of Mains.	Number of		
		Main.	Subsid-	Total.	Cost.	Revenue		Taps.	Hyd'ts	Meters
Maine	208,517	32	10	42	$6,416,940	$687,903	505-95	20,639	1,744	473
N. Hamp..	134,839	29	1	30	2 914,972	178,850	327-21	11,764	1,312	858
Vermont .	67,530	29	0	23	1,391,351	101,962	176-01	7,934	717	389
Mass.....	1.471,041	119	14	133	56,041,382	4,045,282	3,072.78	213,596	21,838	23,964
R. Island.	198,264	11	5	16	9,430,701	576,082	443-35	23.183	3,088	11.341
Conn.....	323.168	41	2	43	8,797,379	822,535	765-40	38,288	3,601	888
Total N.E.	2.409,359	255	32	287	$84,992,725	6,412,624	5,290-70	315,404	32,300	37,913

town with water from Jamaica Pond through pitch pine logs. Two years later Portsmouth, N. H., and Worcester, Mass., started works. The first has been continuously operated since, but the last named works were reconstructed in 1845, and the date of the first works of real importance constructed in each State is shown by the first date in Table 3, viz., 1798 in New Hampshire, 1801 in Massachusetts, 1820 in Vermont, 1832 in Connecticut, 1851 in Maine and not till 1876 in Rhode Island.

How vastly more rapid the recent growth of water-works have been is strikingly shown even by the figures for the New England States summarized in Table 5. There were

		No. Water-Works
Before 1850, a total of		13
In the decade ending	1860 there were built	16
" " " "	1870 " "	32
" " " "	1880 " "	76
" "7½ years "	1888 " has been built	150
A total of		287

Thus considerably more than half the water-works of New England have been built within the last 7½ years, and 78 of them, or 27 per cent. have been built within the last 2½ years. Of course, the newer works supply a much smaller average population than the older ones, which were for large cities only, but the population statistics of Table 5 and others show that a very large fraction of population likewise has only been supplied within the last few years. When we remember that New England is markedly more advanced than any other section as respects water-works, and has within it a large proportion of the water-works dating before 1870 it will be seen at once how strong evidence these tables afford of the rapid growth of a great interest. The similar statistics for the Southern and Western States seem as if everything almost in the way of water-works had been done since 1880.

According to the record of our "Statistical Tables" of 1886, which, while comparatively incomplete, is interesting for comparison, there were:

	In New England	Rest of U. S.	Total
Works built,			
1801 to 1870 inclusive	57	145	202
1871 to 1886 inclusive	161	816	977
Unknown	40	172	212
Total	258	1133	1391
Increase p. c. since 1870.	182½	462	383

We have now, only two years later, 287 water-works in New England, an increase of 29, or 14½ per year, against 10 per year in the very active period 1871-86.

The capital invested in New England water-works has now reached the enormous aggregate of $84,902,725, or $21.20 per head of total population and $35.30 per head potentially supplied. The magnitude of this interest will be better appreciated by comparing it with the railway interest. Taking the figures of the last "Railroad Manual" we have, in even figures:

	Capital invested in Railways	Water-Works	Ratio.
Maine	$40,328,000	$6,417,000	6.27 to 1
New Hampshire	24,474,000	2,915,000	8.39 "
Vermont	34,182,000	1,391,000	24.60 "
Massachusetts	196,618,000	56,041,000	3.51 "
Rhode Island	5,791,000	9,451,000	1 to 1.63
Connecticut	50,274,000	8,797,000	5.71 to 1
Total New England	$351,667,000	84,993,000	4.12 to 1

It will be seen that Rhode Island has nearly twice as much capital invested in water-works as it has in railways, thus enjoying the proud distinction of leading all the States in this respect; but the New England States, as a whole, have nearly one-quarter as much invested.

In revenue the water-works compare somewhat less favorably, their revenue being only $6,412,624 against $66,324,051 of gross and $19,266,191 of net railway revenue. This is but natural, since so very large a proportion of the water-works are public enterprises run purely for the public good to afford water at minimum cost, and without a thought of profit. Nevertheless, their gross revenue is 7.54 per cent. on cost, and the net nearly 7 per cent., as compared with 4.68 per cent. on railway stocks and 4.80 per cent. on railway bonds; so that on the surface they are more profitable than railways. The difference is, however, that there is very little "water" in the water-works capital account, while there is a good deal in the railway capital account, even in New England.

In miles of mains the water-works approach much more nearly to the railways. The figures are, in even miles:

	Miles of mains	Miles of R. R.
Maine	506	1,240
New Hampshire	327	888
Vermont	176	865
Massachusetts	3,073	2,531
Rhode Island	443	150
Connecticut	765	1,010
Total New England	5,291	6,684

Few would imagine, unless told, that the miles of water mains approached so closely to the miles of railway even in New England, largely exceeding the miles of railway in Massachusetts and Rhode Island.

We regret that it is impossible for us, this year, to give the actual financial and operating status of water-works as they stood at the end of each decennial period of the past. The nearest we can come to it in this issue is to show the *present* status of the works first opened in each decade. It must be fully borne in mind that Tables 3 and 5 do no more than this, and hence greatly underrate the growth of the later periods as compared with the earlier ones. Even as it is, the contrast is sufficiently striking. Out of the total investment of $85,000,000 in New England water-works, $13,325,000 has been in *new* works since 1880, and $44,064,000, or more than half, in *new* works since 1870, but of the remaining $41,936,000 now invested in works antedating 1870 fully one-half of it, we judge, has been invested since that date, so that in reality some three-fourths of the total water-works interest even of New England has been created since 1870. In our next annual volume we shall endeavor to give these facts more exactly.

The population statistics given in Table 6 are among the most interesting given. There was an obvious unfairness in comparing States and sections in respect to water-works on the basis of total population, for the reason that it is only in towns that water-works supply is feasible, and a very different proportion of the total population is congregated in towns and cities in the different States. As the U. S. census of 1880 gives a table showing the town population in towns of over 4000 inhabitants we have used that as a basis rather than the total population in all the States. Moreover, we have used only the 1880 census population of the towns in compiling statistics, although we give the estimated present population likewise in the account of each separate work. It is unfortunate that our Government is not sufficiently enlightened to cause a census to be taken every five years in a rapidly growing country like our own, and for lack of it, comparisons of the various groups of States on the basis of the 1880 population only, leads to somewhat deceptive results. To minimize this evil so far as possible we give both the 1870 and 1880 population, with the percentage of increase, and also the percentage of town population in 1880, which shows some striking contrasts. Speaking broadly, every New England State has the whole of its town population supplied by water-works and from 25 to 78 per cent. more of the population in smaller towns likewise so supplied.

The average population per water-works will be seen to be smallest in Vermont, 2,936, in part from the fact that Vermont has no large towns, but also from the fact that Vermont has a far larger proportion of small town works than any other State in New England or the Union. No doubt this is in good part due to a greater abundance and propinquity of good sources of supply, a very unusual proportion of the work being by gravity, as will be seen in Table 9. In large degree the whole of New England enjoys this advantage, as compared with most of the Southern and Western States, and this fact is to be borne in mind in comparisons. Connecticut is at some disadvantage in repect to sources of supply, as will be seen by Tables 8 and 9, and this probably explains the fact that it compares somewhat unfavorably in number of works, especially in the number of works for small towns, for which a small investment only is admissible.

Table 7 gives the facts in regard to the sizes of towns supplied, and from it we may deduce the following percentages of towns of various sizes:

State.	Per cent. of Water-Works for Towns of Under 1,000	1,000 to 3,000	3,000 to 5,000	Over 5,000	Total.
Maine	21.4	28.6	21.4	28.6	100.0
New Hampshire	23.3	36.7	13.3	26.7	100.0
Vermont	17.4	47.8	17.4	17.4	100.0
Massachusetts	7.5	25.6	27.1	39.8	100.0
Rhode Island	18.7	25.0	6.3	50.0	100.0
Connecticut	16.3	18.6	25.6	37.5	100.0
Total New Eng	13.9	27.8	22.6	35.7	100.0

This table shows that Massachusetts is not entitled to so much credit for enterprise, in comparison with her sister States, as other figures might seem to show, since she has by far the smallest proportion of small works for small town supply.

This same fact is indicated by the following Table 8, showing the cost and revenue per tap, mile of main, etc. Massachusetts shows almost the largest investment per head, but the revenue per tap and mile of main is much less in New Hampshire and Vermont, showing that water-works have been very actively pushed in these States. Maine shows a very profitable system of water-works, as is natural from the fact that its works are nearly all private enterprises put up for profit, and of course expecting it. Thrifty Connecticut shows likewise a high rate of profit, perhaps due, in part, to the scarcity of the water supply.

Table 9 brings out the advantage which New England has as respects gravity supply very clearly, more than half the works being so supplied, and more than seven-eights in Connecticut and three-quarters in Vermont. Of the 125 pumping works, 50 pump to reservoirs, 21 to tanks, 31 to stand-pipes and 21 only pump direct to the mains, but there are a number of others which pump direct in case of fire, but which have not been so classified. Compared with other sections, direct pumping is not common in New England, while reservoirs are very largely used.

SOURCES OF SUPPLY.

The various sources of supply specified in Table 10 will be seen to be quite different in the different States. The chief supply of Maine comes from rivers, of New Hampshire, and Vermont from springs, and of Massachusetts from "ponds" and lakes, "pond" meaning in many cases a pretty good sized lake. The large number of 41 out of 123 works are thus supplied in Massachusetts. Rhode Island supplies 7 out of 11 works from rivers and brooks, while Connecticut's chief source of supply is "surface water", no less than 17 being described as thus supplied, out of 41, with 13 others from "brooks and springs", which means a much larger proportion of surface supply, doubtless, than the same terms in the more northerly States.

TABLE 6.

NEW ENGLAND STATES.—POPULATION STATISTICS IN RESPECT TO WATER-WORKS.

[The "town population" is in towns of 4,000 inhabitants or over.

States.	Total Population. 1870	1880	Inc. p. c.	Town Population 1880.	Per c. of total.	Pop'n on Water-Works. Total 1880	P. C. of total pop'n.	P. C. of town pop'n.	Av. pop'n on each Water Wks. Main works only.	Main & sub w'ks together
Maine	626,915	648,936	3.5	135,900	20.9	208,51"	32.2	153.4	6,516	4,965
N. Hamp.	318,300	346,991	9.0	91,400	26 3	134,839	38.9	147.5	4,650	4,494
Vermont	3 0,551	332,286	0.5	37,800	11.4	67,530	20.3	178.2	2,936	2,936
Mass.	1,457,351	1,783,085	22.3	1,175,139	66.0	1,471,042	81.5	125.2	12,360	11 060
R. Island	217,353	276,531	27.2	213,600	77.2	198,264	71.9	92.8	18,024	12,391
Conn.	537,454	622,700	15.8	335 500	53.9	329,168	52.9	98.1	8,028	7,655
Total N. E.	3,487,924	4,010,529	15.0	1,989,339	49.6	2,409,359	59.8	120.6	9,441	8,391
Massachusetts, apart from Boston										8,400

Compare also Table 13.

TABLE 7.

NEW ENGLAND STATES.—CLASSIFICATION OF WATER-WORKS BY SIZE OF TOWN IN 1880.

States.	1,000 or under.	1,000 to 3,000	3,000 to 5,000	5,000 to 10,000	10,000 to 20,000	20,000 or over.	Total No.
Maine	9	12	9	7	4	1	42
New Hamp.	7	11	4	3	4	1	30
Vermont	4	11	4	3	1		23
Mass.	10	34	36	25	15	13	133
Rho e Island	3	4	1	3	4	1	16
Connect't.	7	8	11	7	7	3	43
Total N. E.	40	80	65	48	35	19	287

The smallest work is Drewsville, N. H. (1804), supplying 90 people.

TABLE 8.

NEW ENGLAND WATER-WORKS—COST AND REVENUE PER HEAD, TAP, MILE OF MAIN, ETC.

	Cost per head	Cost per mile of main.	Cost per tap.	Revenue per head	Revenue per mile of main.	Revenue per tap.	Population per tap.	Population per meter.	P. C. rev. to Cost.
Maine	$30.70	$12,700	$311	$3.29	$1,360	$33.30	10.1	440	10.70
New Hampshire	21.60	8,900	217	1.33	548	15.20	11.5	158	6.14
Vermont	20.60	7,890	175	1 51	579	12.85	8.5	173	7.34
Mas-achusetts	38.10	18,250	262	2.75	1,308	18.90	6.9	61	7.21
Rhode Island	47.50	21,3 0	405	2.90	1,296	24.75	8.5	17	6.11
Connecticut	26.80	11.620	229	2.50	1,073	21.40	8.6	37	9.34
Av. N. E	35.30	16,080	269	2.66	1,213	20.30	7.6	63.4	7.54
Boston W. W'ks.	53.90	44,700	352	3.52	2,940	23.10	6.6	117	6.52
Pr'denceW.Wks.	59.40	30 800	474	3.34	1,736	26.70	8.0	14	5.63

TABLE 9.

NEW ENGLAND WATER-WORKS.—KIND OF WORKS.

STATE.	Gravity.	Pumping to: Reservoir.	Tank.	Stand-Pipe.	Direct.	Unk'n.	Unk'n.	Total.	P. C. gravity works.
Maine	10	9	5	3	1	1	1	30	33.3
New H'pshire.	14	6	—	3	5	1	—	29	48.3
Vermont	18	1	—	—	5	—	—	24	75.
Massach'setts.	51	28	13	20	10	—	2	123	41.5
Rhode Island.	1	3	3	4	—	—	—	11	9.1
Connecticut	36	3	1	1	—	—	—	41	87.8
Total N. E.	130	50	21	31	21	2	3	258	50.4

As some of the works have a double system, the totals exceed by 3 that of Table IV. Some other gravity works have small auxiliary pumping systems for special service which have been disregarded.

TABLE 10.

NEW ENGLAND WATER-WORKS.—SOURCES OF SUPPLY.

STATE.	Surface.	Spr'gs.	Brook.	River.	Lake.	Pond.	Wells.	Unk'n.	Total.
Maine	1	5	2	11	4	3	1	3	30
New H'pshire.	—	8	5	4	6	2	2	2	29
Vermont	1	11	2	5	3	2	—	—	24
Massach'setts.	17	15	22	10	13	28	15	3	123
Rhode Island.	—	—	4	3	—	2	2	—	11
Connecticut	17	6	7	3	6	1	—	1	41
Total N. E.	36	45	42	36	32	38	20	9	258
Per cent.	14.0	17.4	16.3	14.0	12.4	14.7	7.7	3.5	100.0

NOTE.—"Pond" in New England often means a good sized lake, and fully two-thirds of the "ponds" would be more accurately described as lakes.

TABLE 11.

AVERAGE WORKING PRESSURES OF NEW ENGLAND WATER-WORKS.

[Representing in some of the gravity works the mean pressure in the mains. In pumping works, however, and in most of the gravity works, the pressure is that at the pumps, or principal mains, and hence considerably higher than the effective pressure.]

PRESSURE lbs. per sq. in.	Maine.	N. H.	Ver't	Mass.	R. I.	Conn.	Total.
20 or under	1	—	—	—	—	—	1
21-30	—	—	—	3	—	—	3
31-40	2	2	—	11	1	2	18
41 50	1	2	1	14	2	4	24
51-60	5	3	1	18	4	4	35
61-70	1	5	3	20	—	5	34
71-80	3	2	3	20	1	8	37
81-90	3	2	2	8	1	3	19
91-100	3	1	3	7	3	6	23
101-110	1	—	2	3	—	—	6
111-120	1	1	—	—	—	1	3
121-130	1	—	2	3	—	2	8
131 140	—	—	—	1	—	—	1
141-150	—	—	—	1	—	—	1
151-160	—	—	1	—	—	—	1
161-170	—	—	—	—	—	—	—
171-180	—	—	—	1	—	—	1
Total works reporting.		18	18	110	12	35	215
Av. pressure lbs.	74	68	90	70	68	76	72½

TABLE 12.

FIRE PRESSURE OF NEW ENGLAND WATER-WORKS, WHEN THE SAME ARE HIGHER THAN THE NORMAL WORKING PRESSURES.

[Nearly all the following are pumping works, but there are a few gravity works which are able to turn on a higher fire pressure from higher reservoirs.]

FIRE PRESSURE, lbs per sq. in.	Me.	N. H.	Vt.	Mass.	R. I.	Conn.	Total.
41-50	—	—	—	3	—	—	3
51-60	1	—	—	1	—	—	2
61-70	1	—	—	1	—	—	2
71-80	—	1	—	3	1	—	5
81 90	—	—	1	4	1	1	7
91-1c0	2	1	—	7	—	1	11
101-110	—	—	2	1	—	—	3
111-120	—	—	1	3	—	2	6
121-130	2	—	—	1	—	—	3
131 140	—	—	—	2	—	—	2
141-150	—	—	1	2	—	1	4
151 160	—	—	—	1	—	—	1
161-170	—	—	—	—	—	—	—
171-180	—	—	—	1	—	—	1
181 190	—	—	—	—	—	—	—
191-200	—	—	—	1	1	—	2
Unknown.	—	—	—	1	—	—	1
Total Works reporting.	6	2	5	32	3	5	53

AMOUNT OF INCREASE ABOVE NORMAL PRESSURE.

10 lbs. or under.	1	—	1	4	1	1	8
11-20	—	—	—	5	1	1	7
21-30	1	2	1	3	—	—	7
31-40	—	—	1	7	—	2	10
41-50	3	—	—	3	—	—	6
51-60	1	—	1	1	—	—	3
61-70	—	—	1	3	—	—	4
71-80	—	—	—	4	—	1	5
81-90	—	—	—	1	—	—	1
150	—	—	—	—	1	—	1
Unknown.	—	—	—	1	—	—	1
Total Works reporting.	6	2	5	32	3	5	53

TABLE 13.

OWNERSHIP OF NEW ENGLAND WATER-WORKS, WITH POPULATION SUPPLIED BY PUBLIC WORKS, ETC.

	Me.	N. H.	Vt.	Mass.	R. I.	Conn.	Total.
City or town	4	7	10	78	5	15	119
Local Company	34	19	10	49	10	27	149
Outside Company	3	4	—	2	—	—	9
Individuals	1	—	3	2	1	1	8
Unknown	—	—	—	2	—	—	2
Total No.	42	30	23	133	16	43	287
Pop'n supp'd by public works	39,792	63.165	42,451	1,280,141	158 758	156.267	1.740.574
Total pop'n on W. W's	208,517	134,839	67,530	1.471.041	198,264	329,168	2,409,359
P. C. supplied by cities	19.2	46.8	63.0	87.0	80.2	47.3	72.3
Pop'n on private works	168,725	71,674	25,079	190 900	39,506	172,90:	668,785
Pop'n per private work	4,440	3.110	1.930	3,470	2.630	6.180	3,980
P. C. of total city pop'n supplied by public works	29.4	69.2	112.2	100.0	74.3	46.5	87.5

It should not be understood that the "surface water" supply is necessarily inferior. We take it that in most cases it is a combination of spring, brook and surface supply, and that many of those which are described as supplied by springs or brooks in other States really have their main supply from the surface rainfall, collected as it always is in an impounding reservoir where it materially purifies itself. Much of the "pond" and even lake supply is also, doubtless, surface water, in many cases.

Supply from wells is as yet far from frequent in New England, there being only 20 works so supplied in all, and wells are likely to remain unusual in New England since the topography favors other modes of supply almost everywhere.

WORKING PRESSURES.

The working pressures range highest in Vermont, averaging 90 lbs. or 18½ lbs. above the average of all New England, 72½ lbs. The lowest working pressure in Vermont is 50 lbs., while the highest, 156 lbs. at Montpelier, is

with one exception in Massachusetts (Cottage City), the highest in New England. In all, 40 works make no report of pressure.

Nearly 90 per cent. of the New England water-works have their working pressures between 35 and 100 lbs., only 4 being lower than the lower limit, as shown more fully in Table 11.

FIRE PRESSURES.

Of the 215 works reporting pressures, 53 report higher pressure for fire purposes, as shown in Table 12. The most common fire pressure will be seen to be 85 to 110 lbs., ranging all the way from 45 to 200 lbs. The average increase above the normal will be seen in the lower part of the same table to be less than 40 lbs., although some works (mostly the smaller ones, in towns which desire to dispense altogether with fire engines) increase pressures 150 lbs. The obvious objection to any extreme change of pressure is the inconvenience and injury to the regular supply.

OWNERSHIP OF THE WORKS.

In this there are some surprising contracts. The great State of Massachusetts shows its greatness and enterprise in nothing more conspicuously than in the public spirited way in which its towns and cities have taken hold of the work of supplying themselves with water at their own expense instead of waiting for private enterprise to do it for them. No less than 78 out of the 133 water-works in Massachusetts are public property, supplying 1,280,144 out of the 1,471,041 supplied, or 87 per cent. By a singular coincidence the latter total comes *within one person* of the total population of Massachusetts in towns of 4,000 inhabitants or over (1,471,041 against 1,471,042) so that we may say practically that every town in Massachusetts of over 4,000 inhabitants has been supplied with water by its own public enterprise, there being in addition 55 private works, supplying an average population of 3,470.

Of no other large State in the Union is anything like this true, but the little State of Vermont does even better, having 12 per cent. more of its population than there is in towns of 4,000 inhabitants or over supplied with water at public expense. It has also a smaller population per private water-works than in any other State, or 1,930 against 2,630 in Rhode Island, 6,180 in Connecticut and 3,980 in the whole New England States. The record of the average population per private water-works, given in the next last line of Table 13, is perhaps the fairest criterion of any of the extent to which a community has been supplied, since the larger works are generally all city works, whose population varies greatly, and so disturbs the value of the average population per water-works of all kinds.

At the other extreme of the New England States comes Maine, with only 4 public works out of 42, and only 29.4 per cent. of its city population supplied by such works. As will be seen from Tables 2 and 3 Maine has likewise been comparatively backward in beginning water-works, more than half of its works having been built within the last two years. On the other hand, it will be seen from the ninth column of Table 6 that Maine is exceeded only by Vermont in its proportion of population supplied by all works, having 53.4 per cent. more than its total city population thus supplied.

These water-works statistics when critically examined, however, bear interesting testimony to a fact which has been often noted, that Maine seems to suffer from the same cause which affects so much more unfavorably the growth of the Canadian maritime provinces; its comparatively isolated position, in a corner of the Union, and with only a very limited adjacent territory with which it is free to trade. In fact Maine is the State to which the provincials turn for comfort when their slow growth is in question, claiming that "they are doing as well as Maine." How true this is in other respects we will not discuss. That it is far from true as respects water-works will be very apparent from statistics to follow; but that this isolation has retarded the development of Maine we have no doubt, and the accompanying figures seem to prove.

The Bad Work on the New Croton Aqueduct.

The plain statement of improper work on parts of the New Croton Aqueduct, as set forth in another page, calls for some plain words on our part as to the responsibility for this state of affairs. It is not necessary to point out the untold dangers that might follow the failure of the water supply of a great city like New York, as a result of these frauds; it is sufficiently criminal in its present commercial aspect without drawing upon future possibilities.

It should be stated at the start that the arching and back-filling of a tunnel furnishes more abundant chances for deceit than a plain piece of work carried on in the light of day; and that these frauds are not peculiar to our own aqueduct is proven by the almost identical iniquity just discovered in the Washington Aqueduct tunnel. But it is because such work needs watching that the Corporation appointed an unusually full staff of engineers and inspectors whose duty it is to see that the contract work is done properly. In the case of the New York aqueduct the inspectors were supposed to be—"Class *A*. Civil engineers of integrity and experienced in masonry construction. Class *B*. Men of integrity and experience, who have made masonry inspection a specialty. Class *C*. Skilled stone masons and brick masons of integrity and experience, etc.". The applicant for a position as inspector applies to the Aqueduct Commission and furnishes a statement under oath as to experience, past employment, etc., and this "statement of facts" must have the indorsement of at least two reputable citizens, testifying to the applicant's sobriety, industry and integrity. This application is transmitted by the Commissioners to the Chief Engineer, who is supposed to again examine the petitioner as to his competency and, if the man is suitable, to certify his approval and return the papers to the Secretary of the Commission. Appointments are made as wanted from these "approved" applicants, and the inspector is assigned to the duty for which the Chief Engineer thinks he is best qualified.

These were the rules formulated in 1886, and they seem to include about all the precautions possible in an attempt to secure honest and capable watchmen. But we understand that later, Civil Service rules have been enforced that destroy in a measure the power of the Chief Engineer as above granted, and make the appointment of an inspector obligatory when he has passed "a formal examination" under other direction and approval. In any event, the system under which the inspectors were appointed who were supposed to inspect the work elsewhere described, must be acknowledged as a signal failure. These men were paid $5 per day, and worked in 8 hour shifts; and while one man had sometimes two or three gangs of masons to watch, it was more usual to have only one. The class of talent actually secured in many cases can not only be judged by the bad work found, but also by the frequent charges of absence from the work, drunkenness on or off the work, etc. The discharge of an inspector for incompetency or faithlessness, involved the unrolling of considerable red-tape, and cases have been brought to our notice where inspectors properly discharged by an engineer, after five weeks earnest effort, have bobbed up within a week on an adjacent piece of work. In other words, some at least of the inspectors owed their positions rather to the influence of outside parties than to their personal fitness for the place; and it is not to be wondered at that such men should see fit to wink at any amount of wickedness perpetrated.

How far the city is responsible for the incompetency or dishonesty of its agents in the shape of its inspectors is a question that we are not called upon to discuss, especially as the contract and specifications have little if anything to say upon this subject.

The contractor is the man who must make good all bad work detected, under the terms of his contract which call for the construction of the tunnel in "a good, substantial and workmanlike manner." The contractor may or may not profit to any great extent by the bad work; he may gain nothing from rascality that is due primarily to the laziness of his agents; but when a void is reported and estimated as filled with masonry for which he is entitled to a price of $6.00 or more per yard, there would certainly be a very considerable profit to him, and he must stand the charge of a guilty knowledge when these vacancies occur with any frequency. He has the greatest interest in watching the progress of his work and studying the amount of work he can get out of his men, and it is hardly possible that a return of one week's work done in a one night shift should escape his notice. He knows better than anyone else what his workmen can do in a given time, and would naturally be the first man to note any phenomenal and unusual progress. Any denial of such knowledge implies a want of personal attention to the details of his work very unusual in contractors as a class; such attention, in fact, as was absolutely demanded by the importance and conditions of the work in question. This remark applies with greatest force to the presence of extensive voids, such as are elsewhere described; minor cheating and scamping of work could go on to a certain extent without the knowledge of the contractors, in small sections of work covered out of sight in an hour or two, where the chief, and perhaps the only incentive, was a desire on the part of the foreman to secure a cheap reputation for "pushing work", and at the same time to avoid hard work.

So much for the contractors and inspectors. Let us now see how it stands with the engineering force, with which we are more immediately interested.

The engineering force on the work, we may repeat, was and is, unusually large. It consists, except as it may have been recently modified, and apart from the office force of clerks, draughtsmen and office assistant's, of

1	Chief Engineer over	30	miles.
1	Consulting Engineer over	30	"
2	Principal asst. engineers, each over	15	"
5	Division engineers, each over	6	"
16	Assistant engineers, each over less than	2	"
54	Transitmen, levelers, rodmen, chainmen and axemen, or one to every	0.56	"
54	Inspectors, or one over every	0.56	"
23	Laborers attached to engineering force as assistants to the engineering parties.	—	"
158	Total engineering force on tunnel, or one to every	0.19	"

In other words, here is a force of more than 5 persons per mile in all on the engineering staff, organized in five different grades of responsibility, viz., assistants to engineering parties, inspectors, assistant engineers, division engineers, principal assistant engineers and chief engineer. We know that this engineering staff was well organized and remark

ably well equipped with all the appliances deemed necessary for the most careful work, and they had a great deal of the latter to do. But notwithstanding the consumption of time in routine engineering duties, there should have certainly been enough left to also keep a sharp eye on the nature of the work going on about them. Judging from the amounts of the bills for repair of faulty work, the engineers on somewhat over one-half of the aqueduct can answer that their inspection has been rigid, and that the amount of work condemned under reinspection has been comparatively light to date, although this labor is yet uncompleted. On the First Division, or the half of the remainder of the tunnel, the engineer in charge has been vigilant enough, and according to the testimony taken in Jan., 1888, at a hearing called to consider the charges of bad work, he had caused much work to be condemned almost from the start of the masonry. It was condemned, but for reasons not stated, much of it was not at once rebuilt, and these repairs have practically only now been completed.

It is on the Second Division, the one inspected by this journal last week, that the most flagrant cases seem to have occurred, where the voids over the arch are by far the most extensive and frequent, and where the 800 barrels and more have been found. Here the Division Engineer and his assistants cannot be held blameless, or even credited with ordinary vigilance in watching over the work intrusted to their care and for which they were responsible. The grave cases seen last week were the early results of a second reinspection under more careful control, and from the cases that had been passed no one can foretell the extent of the bad work on this section of the tunnel until the whole 7 miles are gone over again. Given full credit for any ordinary carelessness in inspecting his work, we fear the engineer in charge will find it difficult to answer for the more extensive and costly voids. The tunnel is carefully cross-sectioned throughout its length at very short intervals and the data is at hand in his office to at any time compare the quantity of masonry returned with the time taken for its completion. We understand he had daily returns of the work performed; and yet a hole, such as is elsewhere described and cubing nearly 300 yds., must necessarily have been closed at one end in a single night-shift, so as to remove the risk of detection in the daytime. The commonest experience in masonry and the minimum of comparison of results with means and time to effect these results, should have shown the engineer that an impossibility was reported and the closest scrutiny invited. A daily report was not even necessary to put him on his guard, for such a cavity called for a week's work at least, under the conditions in which this tunnel arch should have been back filled. The acceptance of work under conditions as above described can only be explained by the grossest incompetency in the engineer, or a knowledge that the void existed and all else that the latter charge might imply; there are only two horns to the dilemma, and both are uncomfortably sharp.

To properly apportion the responsibility for the various classes of bad work on the Aqueduct is a very difficult task. In the controversy now going on, the inspectors are the men who are mainly catching it. The contractors claim that they were compelled to do the work to the satisfaction of these men, and that if the inspectors passed improper or fraudulent work, they—the contractors—are morally and commercially relieved of all responsibility by reason of this act and acceptance by the agents of the Corporation. But this claim will not hold good. The plain statement of the case is that the Corporation proposed to pay certain item prices for the performance of certain specified work: and the contractor, on his part, obligated himself under penalty to do this work in a good, substantial and workmanlike manner. The contractor has not done his part in the case of the work condemned, and no amount of rascality on the part of either his own or the city's agents can shield him from the responsibility for the bad work, nor prevent the Corporation from enforcing the terms of its contract, which enable it to repair all condemned work at the contractor's expense.

The direct responsibility of the contractor has been already touched upon. He is the party most interested in any sham work, for he is the one who will gain the most, financially, from its existence. He may properly be held blameless in intent for a certain amount of minor bad work resulting from the mere viciousness or laziness of his subordinates; but he must be held to a strict account for such grosser faults which could not possibly exist without his knowledge, if he paid the slightest attention to the progress and cost of his work.

The engineering responsibility is great throughout this whole affair; for the engineer in direct charge is the chief responsible barrier against fraud, and upon him the Corporation depends, first of all, for protection. This engineer can no more hide himself behind the misdoings of the inspector than can the contractor, for an essential part of his duty is to inspect the inspectors. That this inspection was difficult, under the Aqueduct conditions, no one will deny; and that some fraud of intent, incompetency or laziness should escape even a vigilant engineer, is not to be wondered at. But it was in his power, and it was his plain duty to keep a sharp lookout and to detect such frauds as have been described, and any omission in this direction lays him open to the most serious charges of gross carelessness in not finding them, or of corrupt practice as an engineer if he knew of their existence and made no effort to remedy the wrong. The responsibility in the engineering staff ascends to the extent consistent with the routine duties of the various grades. But practically it is the duty of each higher engineer to closely watch his engineering subordinates and to form some opinion as to their fitness for the position held, and to promptly take steps to remove the incompetent. The power of dismissal properly lies only with the highest in authority; but if this authority does not see fit to act upon the reports submitted, the subordinates have at least done their duty, and the responsibility rests where it belongs, at the top of the ladder.

Reduced to its simplest form then, the responsibility for the present Aqueduct scandal must be first shared by the contractors and engineers most directly interested; and in this apportionment of blame the inspectors come last, as the men from whom the least was to be expected.

PERSONAL.

J. M. MITCHELL, has been appointed a member of the New Hampshire State Railway Commission, to succeed E. B. P. SANBORN.

J. H. SETCHEL, late Superintendent of the Brooks Locomotive Works, has accepted the position of Superintendent of the Martin Anti-fire Car-heating Co.

T. C. CLIFFORD, late Superintendent of the St. Paul Division of the Wisconsin Central, has been appointed Superintendent of the Chicago Division of that company, with headquarters at Chicago, in place of W. A. GARDNER, resigned.

G. A. EDDY, of Leavenworth, and H. C. CROSS, of Emporia, Kan., have been appointed Receivers of the Missouri, Kansas & Texas Railroad.

J. H. BEST, Jr., has been appointed Traffic Manager of the Quincy, Omaha & Kansas City Railway Co., with headquarters at Quincy, Ill.

J. S. WILSON, general freight traffic manager of the Pennsylvania Railroad system, has tendered his resignation to take effect Oct. 15.

Judge R. I. DORSEY has taken possession of the Rome & Decatur R. R. as Receiver, and appointed Maj. R. BACON, Superintendent.

A. J. MCCABE has been promoted to the office of Acting Superintendent of the Dakota division of the Northern Pacific Railroad.

WM. A. CRAWLEY, having resigned as Purchasing Agent of the Richmond & Allegheny R. R., to accept other employment, the office is abolished.

E. BOWDEN, Superintendent of the Evansville & Terre Haute, the Peoria, Decatur & Evansville, and the Evansville & Indianapolis railways, (the MACKEY system) died at Evansville, Ind., October 4.

T. G. MOOREHEAD, formerly with the Panhandle, has been appointed Superintendent of the Western division of the New York, Pennsylvania & Ohio.

WEBSTER SNYDER has resigned the position of Vice President and General Manager of the Gulf Colorado & Santa Fé R. R. to become General Manager of the Mexican International Railway.

M. V. SMITH, Metallurgical Engineer, of Pittsburgh, Pa., has been made Consulting Engineer to the Minnesota Car Co., of Duluth, Minn., with headquarters in Pittsburg.

C. H. PRESCOTT, recently General Manager of the Oregon Railway & Navigation Co., has been appointed Second Vice-President of the Northern Pacific Railroad, with headquarters at Tacoma, W. T.

JOHN EVANS, formerly Assistant Superintendent of the Northern Pacific Railway, has been appointed Superintendent of Motive Power of the Oregon Railway & Navigation Co.

CHARLES W. CASE has been appointed General Superintendent of the Manitoba Railroad, with headquarters at St. Paul. W. G. COLLINS will fill the vacancy in the Milwaukee & St. Paul road caused by the resignation of Mr. CASE.

D. RICHMOND, Engineer of the middle division of the New York State canals, died on October 4. He was 46 years of age and had been connected with the State canals nearly 25 years.

EDWARD A. GREENE, M. Am. Soc. C. E., has resigned his office of Chief Engineer of the Zanesville & Ohio River Ry. the Shawnee & Muskingum River Ry. and the New York & Shawnee Coal Co., to engage in contract work, with address at 114 S. Fairfax St., Alexandria, Va.

JAS. D. SCHUYLER and WM. HAM. HALL, State Engineer of California, have formed a copartnership and are about to open offices in Los Angeles and San Francisco. Their specialty, we assume, will be hydraulic engineering in its various branches, as both these gentlemen are well known in that line.

IT is reported that A. L. MOHLER, late General Superintendent of the Manitoba R. R., will be made General Manager of the Willmar & Sioux Falls line and the Duluth, Watertown & Pacific Railroad, with headquarters at St. Paul and that ex-Controller A. H. BODE has been made General Passenger and Freight Agent of these lines. Both men will assume their new duties at once.

FRANK P. DAVIS, Civil Engineer, of Washington, D. C., has accepted the appointment of Professor of Civil Engineering in the Corcoran Scientific School of Columbian College, Washington. Mr. DAVIS is a graduate of the University of Michigan, was for several years an Assistant Engineer in the Sewer Department of Washington, and only recently returned from Nicaragua, where he was a Division Engineer on the survey of the proposed canal. The articles on Washington Municipal Engineering, published in 1886 in this journal, were prepared by Mr. DAVIS.

CHARLES DROWNE, C. E., B. N. S., A. M., emeritus professor of mechanics at the Rensselaer Polytechnic Institute, died the early part of this month in Canaan, N. Y. He was born July 5, 1824. In 1847 he was appointed instructor of mathematics and physics at the Institute; in 1849, adjunct professor of mathematics; 1851-55, he held the professorship of mathematics, astronomy and geodesy. In 1859 he was appointed Senior Professor, and in 1860 was made Director, which office he held until 1875, resigning on account of ill-health. By his personal efforts the course of study was broadened, examinations were made more rigid, and a higher standard of scholar-

ship was maintained. He was married in 1872 to Frances E. Bortells of Palmyra, N. Y. After leaving the Institute he traveled for his health for several years in Germany.

R. P. LUKENBILL, Purchasing Agent of the Florida Railway & Navigation Co., died recently at Fernandina, Fla., of yellow fever.

J. D. PILL, formerly Agent of the Cincinnati, Hamilton & Dayton Railroad, at Dayton, O. has accepted the position of Commercial Agent of the Texas & Pacific Railway.

J. H. DECKER, Secretary of the American Water-Works Association, has his office at Winfield, Kan., where communications relative to the Association should be addressed. Mr. DECKER is Secretary, Treasurer and Manager of the Winfield Water Co.

HENRY MONETT, General Passenger Agent of the New York Central & Hudson River Railroad, died of pneumonia at Yonkers, N. Y., on Oct. 9. Mr. MONETT was not quite 35 years old. He had been connected with the passenger departments of the Pittsburg, Cincinnati & St. Louis, Nickel Plate, and West Shore railways. He was appointed General Passenger Agent of the New York Central on Feb. 1, 1887, succeeding the late DANIEL M. KENDRICK.

PUBLICATIONS RECEIVED.

Nineteenth Annual Report of the State Board of Health of Massachusetts. Boston, Mass., 1888. 375 pp.

This report contains much matter of interest and value to the profession. The section on "Water Supply and Sewerage," fills 95 pages, and contains notices of places which have made application to the Legislature for power to introduce a water supply, and places which have proposed to adopt systems of sewage disposal. Details are given, accompanied by full tabular statements, of the results of analyses and examinations of water from different sources. There is also an interesting paper on "Purification of Sewage by Applying it to Land," and this part of the volume concludes with the reports of the Chief Engineer (Mr. F. P. STEARNS) and the Biologist, and the text of an Act to protect the purity of inland waters. Mr. FRED. BROOKS contributes an illustrated paper on "Sewage Disposal at Medfield, Mass." There are also the reports of the inspection and analysis of foods, drugs, etc., and a summary of the weekly mortality reports from the towns and cities of the State. A paper of interest to architects is one on "The Ventilation of School Rooms Heated by Stoves," by J. G. PINKHAM, M. D., which is illustrated by plans and sections of school rooms, and a number of diagrams showing the result of observations of the ventilation of different schools.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The following new members were elected Oct. 3.

FOR MEMBERS.

WILLIAM BARKER LANDRETH, (Union Coll., Schenectady, 1881), Constructing Eng., Amsterdam (N. Y.) Sewers, Schenectady, N. Y.

CHARLES LEVINGS, Chief Engineer, Chicago & Atlantic Ry., Chicago, Ill.

CHARLES ABBOTT LOCKE (La Grange, Tenn., Synodical Coll., 1861), Ass't Eng. Corps of Engineers, U. S. A., in charge Cumberland river, Kentucky and Tennessee and its tributaries, Nashville, Tenn.

GOUVERNEUR MORRIS (Pol. Coll., Pa., 1867), Section 7, New Croton Aqueduct, Ardsley, N. Y.

GEORGE THOMAS NELLES, (Rens. Pol., 1877), City Eng. Leavenworth; Chief Eng. Leavenworth Rapid Transit Ry.; Chief Eng., East Omaha Land & Improvement Co. Leavenworth, Kan.; proposed by M. J. BUTLER, S. WALTERS FOX, ANDREW ROSEWATER, A. J. TULLOCK and S. L. YONGE.

FRANK CHITTENDEN OSBORN, (Rens. Pol., 1880), Member of the firm ROBERT W. HUNT & Co., Bureau of Inspection, Tests and Consultation, Pittsburg, Pa.; proposed by ALBERT FINK, DAVID GREENE, WM. METCALF, C. L. STROBEL and EDWIN THACHER.

CHARLES FRANCIS POWELL, (U. S. Mil. Acad., 1867), Eng. 13th Light House District; also engaged improvement various rivers; Advisory Eng. on construction of bridge over same river at Salem; Secretary Mississippi Commission and Secretary of and Assistant to the Construction Committee of the same; Captain of Engineers, U. S. A.

NATHANIEL EDWARDS RUSSELL, (Rens. Pol., 1870), in charge Construction Bridge connecting tracks U. C. & B. and U. & B. R. Rs., Utica, N. Y. (address Lansingburgh, N. Y.)

ISAAC AUSTIN SMITH, Chief Eng., St. Louis Transfer Ry. and Wiggins Ferry Co.'s, Lebanon, Ill.; proposed by EDWARD FLAD, HENRY FLAD, M. L. HOLMAN, W. S. LINCOLN and ROBERT E. MCMATH.

LINTON WADDELL STUBBS, Res. Eng. V. S. & P. and Vicksburg and Meridian R. Rs., Monroe, La.; proposed by M. S. BELKNAP, G. BOUSCAREN, H. St. COPPEE, G. B. NICHOLSON and W. H. WILEY.

JUNIORS.

TORAGORO KONDO, (Imp. Univ., Japan, 1887), Assistant to Chief Eng. National Water-Works Co., Kansas City, Mo.; proposed by W. H. BREITHAUPT, WM. D. JENKINS W. KIERSTED, WM. B. KNIGHT and J. A. L. WADDELL.

FRANK PARSONS LANT, Ass't Eng. in charge preliminary location from Armstrong Creek to top of Blue Ridge Mountain, Charleston, Cincinnati & Chicago R. R., Marion, N. C.; proposed by J. W. FERGUSON, JOHN D. FOUQUET, WALTER KATTE, MILLER A. SMITH and G. H. THOMSON.

THOMAS KENNARD THOMSON, Draughtsman in Bridge Department, Pencoyd Iron Works, Pencoyd, Pa.; proposed by JAMES G. DRAGON, W. A. DOANE, JAMES ROSS, J. W. SCHAUB and C. C. SCHNEIDER.

JOHN BOGART, *Secretary.*

Engineers' Club of Kansas City.—Regular meeting Oct. 1. President WM. B. KNIGHT in the chair. 14 members and 5 visitors present. Messrs. JOHN M. WALKER, S. H. YONGE and H. H. FILLEY were found elected Members and S. P. MAYBACH as Associate Member.

The Secretary announced that arrangements had been completed by which the Club would have the exclusive use of a small furnished room in the Y. M. C. A. Building for a library, and of the adjoining two rooms for meeting twice a month for $15 per month.

It was stated that papers had been promised for nearly every meeting up to March.

A letter from Mr. C. R. TAYLOR was read describing a new patent street pavement.

Mr. A. J. MASON read a paper entitled "The Complete Sewerage of Kansas City," which was discussed by Messrs. G. W. PEARSONS, GILLHAM, KNIGHT, KIERSTED and ALLEN.

Civil Engineers' Society of St. Paul. The Society held a meeting at the Ryan Hotel, Oct. 1. An interesting paper was read by C. F. LOWETH on "Some Tests of Angle Iron." This was followed by a paper on "Railroads and Highways in Norway," by A. MUNSTER.

The American Institute of Electrical Engineers, of New York.—At a meeting held on Oct. 9, in the rooms of the American Society of Civil Engineers, discussions by papers were offered on a paper read by FRANK J. SPRAGUE, on June 19, entitled, "The Solution of the Municipal Rapid Transit Problem," by Mr. LEONARD, of Richmond, Va., and Mr. RIES, of Baltimore, Md. A paper by A. ROBINSON, of Lewiston, Me., entited a "Note on Gearing for Electrical Railway Cars," was also read by the secretary. The discussion was principally confined to the objections and difficulties mentioned by Mr. LEONARD regarding the electric railway now in operation in Richmond, all of which were of a local nature and readily explained by Mr. SPRAGUE, who constructed this line. He also stated that since that road had been in operation, many improvements had been made and difficulties overcome, and that the road which he is to put in operation in Boston in 4 or 5 weeks would do away with all the difficulties that had been mentioned. The question of storage batteries was also discussed, in connection with the overhead wire system, and Mr. SPRAGUE stated that while he was anxious to have it become a success and was constantly experimenting with it, that it would never be possible to use it on heavy grades and where the weight of transportation was very large. The question of having two motors on each car instead of one, and direct coupling were also mentioned. After a few congratulatory remarks by Mr. C. E. EMERY, and reading notices of next meeting, adjournment was made until Nov. 13.

Architectural League of New York.—The Architectural League has instituted, in connection with its exhibition, an *annual competition*, open to all draughtsmen in the United States under the age of 25, to promote good design and improvement of draughtsmanship.

As prizes, it offers a gold and silver medal. Competitors must be residents of the United States, and under 25.

Programme: For the second annual competition the drawings shall exhibit *The Tomb of an Illustrious Architect.* The base course of the tomb not to exceed in area 144 sq. ft.; the size of the plot, 25×25 ft.

Each contributor to exhibit two sheets of drawings; one to contain plans and elevations at the scale of ⅛ in. to the ft., and one to exhibit a perspective view. The plan and elevation sheet to be finished in line with India ink and the lining pen. No brush-work on this sheet, except sections. No shadows are to be cast.

The perspective to be rendered at will. Each sheet to be cut to the uniform size 24×32 ins., and to be white card or Bristol board, or Whatman paper mounted on a stretcher. No colored borders, frames or glazing will be allowed.

Each sheet must be distinguished by a motto or cipher. A sealed envelope bearing the same motto or cipher must contain the name, full address, place and date of birth of the author, and must be mailed to the office of the Secretary, Mr. FRANK A. WRIGHT, 47 Liberty Street, New York City, with drawings delivered flat, carriage paid, on or before Dec. 5, 1888. JOHN BEVERLEY ROBINSON,

President.

CONSTRUCTION NEWS.

RAILROADS.

East of Chicago.

Existing Roads.

Canadian Pacific.—Grading is to begin at once on the extension from London to Windsor, Ont. The located line runs a mile and a half north of the village of Glencoe, and about the same distance north of Newburg.

Cleveland & Canton.—It is now stated that the company will not purchase the Chagrin Falls narrow gauge, but will build an independent line to Chagrin Falls. Preliminary surveys for the new line have been made.

New York & New England.—The continual rise in the stock of this company is puzzling all the Wall Street sages, with the exception of those who have inside information of the deal. The report that the Vanderbilt were quietly gathering in a controlling interest has found its believers, as has another report that the Pennsylvania and the Erie are each anxious to pick up a controlling interest. It is also announced that the company will build a new line from Danbury, Conn., to White Plains, N. Y., and that it has made a contract with the Harlem to haul its trains from that point to New York City.

Pennsylvania.—The annual fall inspection of the lines of the system is in progress.——Some changes are to be made about Pittsburg to enable through east bound freight to be taken around the city. Much of it now goes *via* Allegheny and Bolivar Junction and by Port Perry. Surveys are in progress for the new Smoky Island bridge and with the completion of this and the connecting tracks, the Pennsylvania will have a belt line entirely around the city.

Bangor & Piscataquis.—Offers have been made for the controlling interest in this Maine road, held by the city of Bangor. The Castine & Bangor Railroad Company, which proposes to build a railroad from Bangor to Castine, on the coast, and FRANK JONES of Portsmouth, N. H., have each made a proposition. A committee of the Bangor City Council has reported against the acceptance of either offer, but a public meeting to discuss the subject is to be held Oct. 16.

Western New York & Pennsylvania.—This line is to be double tracked from Hinsdale to Olean, N. Y., a distance of 7 miles.

Turtle Creek Valley.—The surveys for this line up the Turtle Creek valley near Pittsburg, Pa., have been completed. It is stated that the road has been bought by the Pennsylvania.

McKeesport & Belle Vernon.—Trains are expected to be running over this road, which runs from McKeesport Pa., up the Monongahela valley, as far as Elizabeth, by Nov. 1.

Flint & Pere Marquette.—A survey is to be made for a branch to Simmons Mills, near Coleman, Mich., a distance of 4½ miles from the present line.

Cincinnati, Indianapolis, St. Louis & Chicago.—The report of President INGALLS, presented at the annual meeting, shows for the year ending June 30, gross earnings of $2,797,670, and expenses to the amount of $1,658,158, leaving as net earnings $1,137,512. Thus the company earned nearly 6 per cent. on the capital stock. This is on a mileage of 302 miles, some of the leased lines being reported separately. A large quantity of 67-lb. steel has been laid to replace the 56-lb. rails now in the track, and the old rails have been largely used for sidings Reference is made to the new Chesapeake & Ohio line from Cincinnati to the seaboard, which it is expected will add largely to the through business over the "Big Four."

Hereford.—The trouble with the laborers on the Hereford Railway is now seemingly over. The facts we have been able to gather are these:

The contractors, Messrs. Shirley, Corbett & Co., (who, it is reported, contracted for the work at a lump sum less than the engineer's estimate, and who were awarded the contract on furnishing bonds for only $5,000), ran in debt for wages, plant and supplies, and were constantly at war with the engineers, through failing to work in accordance with the specifications. The wet season was also against them, so, on receiving the amount of their August estimate, they begged for the return of the $5,000 forfeit to meet some extra bills. This was given them and then they quietly skipped.

The laborers (Italians, Finns, Swedes, Greeks and French) whose August pay was due Sept. 20, waited until the 24th, and then, seeing no sign of its coming, struck. They refused to begin work again till paid up to date, and as that could not be done, they tore up some track, disabled the plant, and stole provisions and a large quantity of dynamite. Those who were not possessed of revolvers and knives, armed themselves with weapons made from their working tools.

An attempt was made by the company to settle the matter by promising regular pay in the future, but this did not quiet the strikers, so the militia were called out. These managed to cow the men after some more or less serious skirmishes; and most of the latter are now at work again, in the belief that the company will at any rate pay their September wages.

New Projects and Surveys.

Rochester & Honeoye Valley.—A new survey is being made for this projected railway about 16 miles in length, near Rochester, N. Y. H. D. MCNAUGHTON, of Rochester, is President; and A. GRANT CHILDS, of Kingston, N. Y., is Chief Engineer.

Toledo & Chicago Air Line.—M. MERCER, of Goshen, Ind., is reported to have organized a company in that city to build a railway from Toledo to Chicago. Mr. MERCER was formerly connected with the Canada & St. Louis railway.

SOUTHERN

Existing Roads.

East Tennessee, Virginia & Georgia.—It is announced that at a meeting of the directors of this company held in Wall Street on Oct. 9, a resolution was adopted directing President SAMUEL THOMAS to at once put an engineer corps in the field to survey a line from Eastman, Ga., to Savannah, and to open negotiations for the purchase of four large ocean steamships to ply between New York and Savannah. The proposed line would be over 100 miles in length, and would closely parallel the line which the Central Railroad of Georgia is locating from Savannah west.

Louisville Southern.—Ground was broken near Versailles, Ky., on Oct. 11, for the extension chartered as the Richmond, Nicholasville, Irvine & Beattyville, the contract for which has been let to the Ohio Valley Improvement Company. The Louisville *Courier Journal* of Oct. 9 said:

"This enterprise, which is to accomplish so much toward the development of Kentucky, will be inaugurated with appropriate ceremonies. An eminent divine will be present to invoke the blessings of Providence upon the enterprise. There then will be music and speaking. After this, Miss Maggie Chenault, daughter of Hon. C. D. Chenault, of Richmond, Ky., will roll the first wheelbarrow of dirt, and a photographer will make a picture of the scene."

Jacksonville, Tampa & Key West.—

SEVILLE, Fla., Oct. 1, 1888.

EDITOR ENGINEERING NEWS:—Work will begin this week on the construction of a narrow gauge road from Jupiter to the head of Lake Worth, 8 miles. F. S. HODGES is the contractor and S. K. HOLLISTER is the engineer in charge. It is only intended to secure the Lake Worth business for the Jacksonville, Tampa & Key West and the steamboat service on Indian river which now connects Titusville with Jupiter; but the line is so located that it will naturally form part of a through line. It will be completed for the winter traffic.

Work will also be resumed to day on the St. John's River bridge at Palatka, which will connect the St. John's & Halifax division with the main line. It will be of timber, the most important portions creosoted. The total length will be 4,250 ft.; draw 230 ft. The banks on the St. John's & Halifax Railroad are being widened and the gauge will be made standard on the completion of the bridge. Other extensions and improvements are contemplated. K.

Americus, Preston & Lumpkin.—A survey is in progress for an extension of this Georgia narrow gauge road westward to Montgomery, Ala., about 75 miles. The line will cross the Mobile & Girard Railroad about two miles east of Seale, Ala.

Marietta & North Georgia.—It is announced that Mr. GEO. B. EAGER, who has been abroad negotiating a sale for the bonds of this road, has returned after a successful trip, and a large force is to be put on at once to complete the laying of a third rail on the 50 mile division from Marietta to Jasper and to push the extension north to Knoxville, Tenn.

Versailles & Midway.—The trouble over right of way for the extension of this Kentucky road has been settled and the rails are to be laid at once from Midway to Georgetown, the grading being already finished.

Tennessee Midland.—About 2,000 hands are now employed on the grading of the Tennessee Midland Ry., between Jackson and the Tennessee river. It is probable that contracts will be let soon for the 800 ft. tunnel between the Tennessee river and Centreville.

Cumberland Valley.—Rickert & Keons, of Pottsville, Pa., contractors for the West Virginia division of the extension from Martinsburg to Winchester, Va., have begun grading. Their division is 13½ miles long. King & Wetherill, of Mahonoy City, Pa., have the contract for the division from the State line to Winchester, Va., 9 miles.

Carolina, Cumberland & Chicago.—Tracklaying has been completed on this South Carolina road from Edgefield to Newberry.

Kentucky Central.—It is rumored that if C. P. HUNTINGTON, who owns the controlling interest in this Kentucky road, does not succeed in disposing of it at a fair price he will extend it north to Columbus, O., crossing the Ohio river at Maysville, Ky.

Louisville & Nashville.—The report of President NORTON to the stockholders of this company at the annual meeting at Louisville, Oct. 3, showed that on June 30, 1888, the length of all roads owned, leased or controlled by the company was 4,015.4 miles. The report of earnings included only those lines operated by the company, an average for the year of 2,027 miles, on which the results of the year's operations were:

Gross earnings.....	$16,360,241
Operating expenses (62.76 %).....	10,267,535
Net earnings (37.24 %)...	6,092,706

During the year 70.92 miles of rails in the system were replaced by new steel rails; of which 32.11 miles were to replace iron, and 38.81 to replace steel, at a cost of $108,808. Of the new steel laid 46.38 miles were of the 58¾-lb. pattern, and 24.54 miles were of the 68-lb. pattern.

There were added to the system during the 175.41 miles of new lines.

The number of tons moved one mile was 997,094,252, and the average rate received per ton mile was $1.06, against $1.03 last year, an increase of 2.91 per cent.

The number of freight train miles increased from 6,924,776 miles last year to 7,326,528 miles this year, an increase of 401,806 miles, equal to 5.80 per cent.

The average number of cars hauled in each train was 17.49, and the number of the same in the previous year was 17.94, a decrease of 2.50 per cent.

The average number of tons carried in each train was 147.40.

The average number of tons in each loaded car was 11.59, and the average number of miles that each ton was carried was 81.91.

The whole number of passengers carried was 4,167,916, an increase over the number carried last year of 254,278, equal to 6.94 per cent.

The average fare received was 98.29 cents, against 94.63 cents last year, an increase of 3.87 per cent.

The aggregate number carried one mile was 173,292,336, against 160,345,206 in the previous year, an increase equal to 8.07 per cent.

The number of passenger train miles was 3,748,481 against 3,528,105, being an increase of 6.55 per cent. compared with last year.

The average distance traveled by each passenger was 40.87 miles, and the average rate received per mile from each passenger was 2.40 cents, against 2.36 cents in the preceding year.

At the close of the fiscal year ended June 30, 1887, the equipment consisted of 11,289 cars of all kinds, and 391 locomotives. The additions to equipment during the year were, 1,608 cars and 31 locomotives. Contracts have been let for 1,125 freight cars and 10 consolidation engines to be delivered in November, December and January.

Of the extensions under construction, 53 miles on the Birmingham Mineral railroad should be finished by Dec. 1. The contract was let July 3 for the extension from Pineville, Ky., to Cumberland Gap, 15.7 miles, the tunnels and grading to be completed by April 15, 1889. The whole should be completed to a connection with the Powell's Valley railroad by July 1, 1889. A favorable contract has been made with the Powell's Valley company for the joint use of the Cumberland Gap tunnel.

Ore Belt.—

CEDARTOWN, Ga., Oct. 5, 1888.

EDITOR ENGINEERING NEWS:

The Ore Belt Railway Co. has been formed to build a railway from Cedartown, Polk county, Ga., to Cave Springs, Floyd county, a distance of 15 miles (including side tracks). The capital stock is $230,000, of which $100,000 has been taken by a construction company. The remaining $100,000 has been taken by an equipment company. The object of the road is to open up a rich mineral country. Grading is to be completed within 90 days. We are asking for propositions on steel rail, engines, and freight and passenger cars. A. RICHARDSON is President; J. J. LAMPTON, Vice-President; M. A. WRIGHT, Secretary and Treasurer. The general officers are at Cedartown, Ga. PERCY LUMLEY, *Chief Engineer.*

New Projects and Surveys.

Knoxville Belt.—A company has been organized at Knoxville, Tenn., and has let part of the contracts for building a belt railroad around Knoxville.

THE NORTHWEST.

Existing Roads.

St. Louis, Alton & Terre Haute.—The first train over the new Chicago, St. Louis & Paducah railroad reached Metropolis, Ill., across the Ohio river from Paducah, Ky., on Oct. 3. N. W. IRISH of Carlyle, Ill., was the contractor and Col. E. W. MUENSCHER was Chief Engineer.

Illinois Central.—The Iowa Falls & Sioux City, Cedar Rapids & Chicago, and Cherokee & Dakota companies have been consolidated with the Dubuque & Sioux City company, forming thus a system of 600 miles in Iowa, Minnesota and Dakota. General Manager JEFFREY flatly contradicts the rumors that the company intends to build into Nebraska this year.

Chicago, Burlington & Quincy.—The statement for August shows gross earnings $2,273,702, a decrease of $108,400 compared with August 1887. Net earnings were $68,889, a decrease of $275,516. For the eight months ending Aug. 31, the gross earnings were $14,113,168, a decrease of $3,712,641; net earnings, $2,238,626, a decrease of $5,594,231.

Elgin, Joliet & Eastern.—This Illinois road will be ready for operation by Nov. 1, from Elgin, Ill., to Joliet, Ill., and Hobart, Ind., nearly 90 miles.

Winnipeg & Hudson Bay.

One of the secondary and by no means inconsiderable advantages accruing to the people of Manitoba from the conclusion of arrangements that assure them ample transportation facilities to the markets of the East, is the collapse of the Hudson's Bay railroad scheme. They are to be accounted extremely fortunate in that the development of lines of railway connection with the United States has put a quietus upon a project so chimerical and so costly. For it came very near to being an established and painful fact. * * * * * * The people would hear of nothing prejudicial to their pet folly, and $ 4,500,000 was actually voted in its aid, conditioned upon liberal assistance from the Dominion authorities. It now appears that the Ottawa people are only too glad of the relief offerred them by the situation from a demand which they might have felt compelled to grant when they were insisting upon disallowance of the Red River Valley road. It is announced that the Hudson's Bay road "will have to wait until local traffic develops to such an extent as to demand its construction," which means literally that it will wait until doomsday. Now that the Red River line is an assured fact, and the province is provided with abundant connection under competion, with the outer world, it has no more use for the Hudson's Bay line than for a road to the moon. The people of Manitoba are to be congratulated upon their escape from a scheme which came near saddling them with a tremendous debt, and could have brought them no practical benefit whatsoever.—St. Paul *Pioneer Press.*

New Projects and Surveys.

Duluth & Winnipeg.—It is announced that this company has made arrangements for building its line from Duluth northwest to the International boundary, and has let the contract for the first 50 miles. It is stated that it has purchased from the St. Paul & Duluth company the Short line extension to Thomson and the bridge across St. Louis bay to West Superior. The company has a large land grant, and their proposed line will open up an enormous tract of land on the St. Louis and Cloquet rivers and will cross nearly every logging stream in Northern Minnesota. Among those at the head of the enterprise are W. H. FISHER, formerly President of the St. Paul & Duluth Railroad, and T. B. CASEY, of Minneapolis.

St. Paul, Black Hills & Pacific.—A survey has been made this season from Mandan, Dak., southwest 170 miles, and is being continued on toward Rapid City, Dak. The company will endeavor to secure capital for the building of the line next year. W. L. RICHARDS, of Jamestown, Dak., is Chief Engineer, and L. G. JOHNSON, of Aberdeen, Dak., is General Manager.

THE SOUTHWEST.

Existing Roads.

Missouri, Kansas & Texas.—Judge BREWER has appointed HARRISON C. CROSS of Emporia, Kan., and GEO. A. EDDY of Leavenworth to be Receivers of the Missouri, Kansas & Texas railroad, and they will take possession of the property on Nov. 1. In the order appointing them, mention is made of the Dallas & Waco extension in Texas, the franchise and subsidies for which lapse if at least 10 miles of the line is not completed by Dec. 26, 1888; and the receivers are authorized in their discretion to proceed with its construction.

Cape Girardeau Southwestern.—Contracts for the extension from Williamsville, Mo., to the terminus of the Current River branch of the Kansas City, Fort Scott & Gulf system have all been let and work is to begin at once. The 700 ft. tunnel between Wappapello and Williamsville has delayed the work considerably.

Missouri Pacific.—A branch line from Benton, Ark., on the St. Louis, Iron Mountain & Southern, to Hot Springs, Ark., about 25 miles, has been surveyed and the company is endeavoring to secure right of way for an entrance to Hot Springs. Ground has been broken at St. Louis for a line to run from the St. Louis, Iron Mountain & Southern railroad at the city boundary to the proposed union depot.

New Projects and Surveys.

Memphis, Little Rock & Indian Territory.—The City Council of Hot Springs, Ark., passed an ordinance on Oct. 5 granting this company right of way for an entrance to the city. Ground was broken for the line at a point near Hot Springs on Oct. 2 and Chief Engineer H. A. SCHWANECKE affirms that the contract is let and the line will be built from Hot Springs to Little Rock at once.

Texas Air Line.—It is said that this enterprise, which has its headquarters at Galveston, Tex., has been by no means abandoned, and surveys are now in progress for a branch which will leave the main line in Leon county and will run *via* Fort Worth to the northwestern part of the State. W. L. MOODY, of Galveston, is President.

St. Louis & Colorado.—Incorporated in Kansas by DAVID JENNINGS, of Oswego, and JOHN R. WALKER, and EDWARD BANNISTER, of Springfield, Mo.

Mansfield & Coushatta.—A construction company has offered to build a railroad from Mansfield to Coushatta, La., about 25 miles, for a subsidy of $125,000, which citizens of Mansfield are trying to raise.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Bellingham Bay & British Columbia.—This company is building a railway from Whatcom, W. T., north toward the International boundary, and the rails and rolling stock for the line have been delivered. P. BARRY CORNWALL of Whatcom is at the head of the enterprise.

Salt Lake & Eastern.—About 500 hands are grading a railway from Salt Lake City, Utah, east to Park City, an important mining camp. JOHN W. YOUNG of Salt Lake City is the builder of the road.

Nevada & California.—It is stated that the name of this road has been changed to Nevada, California & Oregon and that the line is to be pushed north into Oregon. The track has now been laid from Reno, Nev., north 70 miles.

Union Pacific.—It is expected that the gauge of the Utah & Northern, on the division between Ogden, Utah, and Pocatello, Idaho, will be changed to standard next spring. The division from Pocatello north to the Montana Union Railroad was widened a year ago.

Mexican National.—The following data in regard to this newly completed road are given by the Denver *Republican*:

This new road opens up a fine country and some of the richest mining sections in Old Mexico. An extension is now building on the Mexican National which will connect it with Manzanillo on the Pacific coast of Mexico, and one of the finest harbors between San Francisco and the Isthmus of Panama. This line branches out at Acamboro for the coast and passes through the States of Mexico, Guanajuato, Michocau, Jalisco and Colima.

The United States line leaving the inter-oceanic line at Acamboro, almost bisects the States of Guanajuato, and San Luis Potosi, and passes through the States of Coahuila, Nuevo Leon and Tamaulipas and by its projected and partly built Pachuca extension, taps the rich little commonwealth of Hidalgo. Tamaulipas is further traversed along its Rio Grande frontier from Matamoras to Mier under the Mexican National Company's Matamoras and Monterey concession.

The Tlascala concession connects the city and State of that name with the City of Mexico. The Zacatecas branch will reach a section of great mineral wealth; and extending from Zacatecas to Logos and San Luis Potosi still further drains the States of Zacatecas, San Luis Potosi and Aguas Calientes. The latest population of the 29 States of the Republic of Mexico in 1880, was 9,701,288.

Fourteen of these States, containing a population of 5,595,965, are tributary to the Mexican National, being almost 1,500,000 in excess of half the population of the republic.

The commercial importance of this new railway system is shown in the following: The assessed real estate valuation of the 14 States tributary to it is $220,881,646, while that of the other 15 States is only $118,040,242. Thus the total real estate valuation of the republic is $338,901,888, as shown by the official reports in the Treasury Department.

The average export of silver from Old Mexico has been about $20,000,000 annually for a number of years, being about ⅔ of the exports of that country. Of this silver the Mexican National claims that from $16,000,000 to $17,000,000 comes from States tributary to it.

The entire system, when the branch lines shall have been completed, will have about 2,000 miles. About 1,500 miles of this will cost $23,000 per mile. On the Pacific Coast branch, now building to connect with Manzanillo, some rough mountainous country will be passed, and at some points it will cost much more. The main object of this road is to develop the rich interior of the Republic, and the city of Mexico has already been reached. With the completion of the line from Acamboro to the fine port of Manzanillo, Corpus Christi, at Aransas Pass, on the Texas coast, will have a direct line to the Pacific coast, thus connecting the Gulf of Mexico with the Pacific ocean. Goods now shipped from San Francisco *via* the Ishmus can reach American territory several days sooner *via* the Mexican National from the port of Manzanillo to Laredo, Corpus Christi and thence *via* San Antonio, Galveston, Houston, Fort Worth and other points.

New Projects and Surveys.

San Luis Valley.—

P. O. BOX 2566, DENVER, Col., Oct. 4, 1888.

EDITOR ENGINEERING NEWS:—The San Luis Valley Railway Company was chartered May 19, 1888, and proposes to build about 200 miles of railway, extending from Pueblo, Col., to Monte Vista, and thence south to La Jara and north to Saguache with a branch down the San Juan river. Surveys began Aug. 10, and about 75 miles of line have been run out. The country is mostly level and the road will have few curves and easy grades. Right of way and grading has been given as local aid, and some contracts have been let. Several existing lines are seeking connections with the road, which it is expected to have completed by Jan. 1, 1890. The road will be the main outlet for a rapidly developing section of 5,000 square miles. G. P. DAVIS, of Hartford, Ct., is President of the company, and WALTER H. GRAVES, Monte Vista, Col., is Chief Engineer.

J. P. BRONK, *Vice President and General Manager.*

Oriental Fronterizo.—This is the name of the company which, as noted last week, proposes to build a railway from Bagdad to Matamoros. The offices of the company are at Matamoros. Don MARCELINO ROGUIR is President, and ANTONIO DESTUGUE is Secretary.

——The Indianapolis Frog & Switch Co. will begin business this month, and will place on the market a new frog invented by T. H. PERRY, Chief Engineer of the Lake Erie & Western Railway. The company expects to employ 50 to 60 hands in the manufacture of this and other specialties. J. E. MCGETTIGAN is President of the company, and C. H. BOSWORTH, Secretary.

Proposals Open.

Bridge.—Under truss wooden bridge 400 ft. long, 12 ft. wide, spans not less than 40 ft. long, across North Loup river, at Elyria, 8 miles above Ord, Neb. Until Oct. 22, by J. A. PATTON, County Clerk.

Well Sinking.—An artesian well 1,500 ft. deep, or until sufficient water supply is reached, to start with 10-in. and terminate with a 6-in. drill. JAS. V. FEIBEL, City Clerk, Scotland, Dakota. Nov. 1.

Viaduct Flagging.—Flagging sidewalks on Central Viaduct between Hill Street and westerly end of viaduct, WALTER P. RICE, City Civil Engineer, Cleveland, O. Oct. 20.

Hydraulic Punching Machine.—One hydraulic, manhole and door punching machine. JAMES FULTON, Paymaster General, U. S. Navy, Washington, D. C. October 27.

Street Improvements.—Excavating, filling with sand or gravel, paving, flagging, resetting curb-stones, curbing, furnishing and laying 300 lin. ft. of 12-in. vitrified ewer pipe, receiving basins and manholes on Chestnut Avenue, and improving Morris Street from Greene to Washington streets. MARTIN FINCK, Clerk, Jersey City, N. J. October 22.

Excavating and Filling City Lots.—Address JOHN P. ADAMS, Commissioner of the Department of City Works, Brooklyn, for blank forms of proposals. October 22.

Dredging.—At the bulkhead between Perry and West 11th Streets, on North River. L. J. N. STARK, J. MATTHEWS and E. A. POST, Commissioners of the Department of Docks, Pier "A", foot of Battery Place, New York.

Pumping Engine, Tank and Water Closets.—For furnishing a pumping engine, tank, water closets and material and work for reconstructing the plumbing, at Essex Prison, N. Y. Department of Public Charities and Correction, 66 Third Avenue, New York. October 20.

Contracting.

The National Water Purifying Co. has made a contract to change over to their system the "Hyatt" filter plant at Huntington, W. Va. The company has also contracted for additional filters to be put in at Chattanooga, Tenn., the increase in the number of consumers, since their first filter plant was put in, necessitating larger filtering capacity. This plant is now of 5,000,000 galls. capacity per day, which makes it the largest mechanical filtering plant in the world,

New Croton Aqueduct.—The Aqueduct Commissioners have awarded to Breuchand, Pennell & Co. a contract for building an iron-lined masonry aqueduct on Section 14, near shaft 30, of the new aqueduct. The firm bid $65,000. The Commission had previously rejected a bid of $62,000, put in by Rogers, Farrell & Co., and ordered a readvertising for proposals. As on the previous occasion, there was only one bid. The Commission was dissatisfied, but Chief Engineer CHURCH recommended the acceptance of the bid, as the land at this point of the aqueduct is so dangerous and insecure that delay would only increase the cost of the construction of the proposed aqueduct.

Laying Water Pipe.—Tenders for laying a 15-in. wooden, fresh water pipe from the Welland canal to the pump house for the Welland, Ont., water-works, have been received by W. L. Leslie, and contract awarded to David Bald, of Welland, at the following prices:

Head gates	$ 475
Excavation, 3,680 yds. at 54 cents	1,987
Laying pipe	1,621
Total bid	$4,083

Bridges.—John H. Lee, County Clerk, Keytesville, Mo., has awarded the contract for an iron bridge, including piling, substructure, etc., to the Milwaukee Bridge & Iron Co., Kansas City, Mo., for $3,000. It will be a combination Howe truss bridge, of 130 ft. span across the Chariton river.——Oxford, Pa. The County Commissioners of Lancaster and Chester counties, Pa., have awarded the contract for constructing a bridge over the Octoraro creek, at Newcomer's Fording as follows: superstructure to M. Wood, for $1,366, and the stone work to Geo. E. Jones, at $2.63 per perch, for cement work. They have also awarded a contract for the superstructure of a bridge over Mill creek, to the Phœnix Iron Co., for $825.

Wire Fence.—The Washburn & Moen Mfg. Co., New York City, has been awarded the contract to build a 19 strand galvanized steel wire fence around the New York State Deer Park, at Big Indian, N. Y. It will be 10 ft. high with iron stays between the posts. They have also been awarded the contract for fencing the extension of the New Berlin branch of the New York, Ontario & Western R. R., to Edmeston, N. Y.

City Work.—***Roanoke, Va.*** The contract for macadamizing, curbing, paving and guttering streets has been awarded to Sexton & Houston, of Roanoke, Va., as follows: Macadamizing, 98 cts. per cu. yd.; paving, curbing and guttering, at $1.31½ per running foot. For furnishing sewer pipe, to J. Franey's Sons & Co., of Toronto, O., as follows; 24-in. 67½ cts.; 12-in. 25 cts.; 8-in. 13 cts.

Railroad.—The contract for the grading and masonry from Martinsburg, Pa. to State line, has been awarded to T. H. Ricket and T. F. Kerns, of Pottsville, Pa., a distance of 13¼ miles, and from State line to Winchester a distance of 9 miles to Chas. F. King and W. E. Wetherill, of Mahonoy City, Pa., by CHAUNCEY IVES, Chief Engineer. The entire work to be completed April, 1, 1889.

Street Railway.—Nebraska City, Neb. A street car company has been formed and construction will commence at once. The officers are: H. H. BARTLING, Pres.; E. S. HAWLEY, Vice-Prest.; E. S. HAWLEY, Sect'y.; W. L. WILSON, Treas.; A. F. NIMS is Chief Engineer. The Johnson 40 lb. steel rail and chair will be used. The motive power will be horses.

Sewers.—Bids for the construction of sewers at Willimantic, Conn., have been opened by John M. Hall. The bidders were: F. B. Durfey, Norwich, Conn.; $8,132.35; E. McManus, Waterbury, Conn., $6,528.25; Cadwell Bros., New Britain, Conn., $5,969.90; Jacoby & Madden, Bridgeport, Conn., $,475.05. The contract was awarded to Jacoby & Madden.

Paving.—***Burlington, Ia.***—The contract for paving Main Street from Maple to Columbia Streets, has been awarded to E. Kropp & Co. at $28,980.

Water Works.—The contract for complete water-works, comprising 1¼ miles 4, 6 and 8 in. improved Wyckoff water pipe, 14 D. D. Hydrants, valves, special castings, 1 set duplex pumps, 2 boilers, etc., except pump house, for Anicomining, Mich., has been awarded to the Michigan Pipe Co., Bay City, Mich., Henry B. Smith, Sect'y. & Treas. Works are to be completed within 60 days.

Dams.—Appleton, Wis. Plans have already been prepared by Government engineers for a new dam across the river to take the place of the old third dam, and orders are daily expected from the war department to commence the work. Five (5) sluice gates are provided for in the plans, this being the same number used in the upper Government dam.

Dredging.—Mobile, Ala. The following bids for dredging Mobile Harbor were received by Major A. N. DAMRELL, U. S. A., on September 15. (All bids were for work per cu. yd.). T. H. Handy, New Orleans, La., 12 cts.; National Dredging Co., Wilmington, Del., 10¼ cts.; Alabama Dredging & Jetty Co., New Orleans, La., 9 cts.; J. H. Gardner, New Orleans, La., 9⅞ cts.; Atlas Dredging Co., Wilmington, Del., 14 cts.; P. Sanford Ross, Jersey City, N. J., 12¼ cts.

Pumping Engines—The Dean Steam Pump Co., of Holyoke, Mass., has recently sent pumping engines to the water-works at Decatur, Ala., and Watertown, D. T.

Dayton, O.—Bids for furnishing a pumping engine for the National Military Home, have been received from the following parties: J. K. Rugg & Co., Cincinnati, O., $3,775; National Iron Works, New Brunswick, N. J., $2,900 for a pump of 1,500,000 galls. capacity or $7,000 for a pump of 2,000,000 galls. capacity. The Gordon Steam Pump Co., Hamilton, O., $3,200; Smith & Vail & Co., Dayton, O., $21,385.62. The contract has not been awarded.

Pipe.—The contract for furnishing 1¼-in., 1½-in. and larger water pipe to the National Military Home, Dayton, O., has been awarded to Gibbons & McCormick, at 58 and 68 per cent. from list price.

Sewers.—***South Omaha, Neb.***—The City Engineer has let a contract for the furnishing and laying of 10,200 ft. of 24-in. double strength pipe, to C. M. O'Donovan, $2.25 per ft.; 2,100 ft. of 12-in. double strength pipe at 85 cts.; 1,600 ft. of 15-in. double strength pipe at $1.15, and 4,808 ft. of 8-in. double strength pipe at 61 cts.; catch basins, $3.40 per ft.; manholes, $3.40 per ft., of hard burned brick; concrete, $5.50 per cu. yd. The bidding was very low as the 24-in. pipe will average 12 ft. cut; 15-in. pipe, 8 ft.; 12-in. pipe, 14 ft.; and 8-in. pipe, 16 ins. E. B. TOWL is City Engineer; R. H. LAWRENCE, Assistant City Engineer.

Drainage.—The New York Life Insurance Co. has accepted the proposal of the Durham House Drainage Co., of New York, for furnishing the drainage system of their eight-story office building in Montreal, for $4,850

Asylum.—The contract for building the North Texas Insane Asylum at Terrell, Texas, has been awarded to Robert L. James, Dallas, Tex., at $125,000.

Gas Works Extension.—T. William Harris & Co. 44 Broadway, New York, have been awarded the contract for extending the Dobbs Ferry and Hastings, N. Y., gas works. New pipes will be laid at both Dobbs Ferry and Hastings.

Water-Works.—Proposals for furnishing supplies and doing all work for a complete system of water-works, at Sidney, O., have been received by GEO. HORNUNG, Consulting Engineer, of Cincinnati, O., as follows:

Stop Valves.—4 8-in.; 4 10-in.; 5 12-in.; 2 14-in.; 2 16-in.; 1 20-in. with flanges: Chapman Valve Mfg. Co., total bid $808.84; Bailey, Farrell & Co., $830.33; Bourbon Copper & Brass Works; total bid $800.; Contract awarded to Bourbon Copper & Brass Works.

Cast-Iron Pipe and Specials.—Addyston Pipe & Steel Co., $3,562.22; McNeal Pipe & Foundry Co., $3,967.25; R. D. Wood & Co., $3,608.60. The contract was awarded to the Addyston Pipe & Steel Co.

Standpipe.—Tippett & Wood, $8,500; Porter Mfg. Co., $6,900; Keating & Houston, $9,800; Stacy Mfg. Co., $9,125; Shickle, Harrison & Howard, $8,990; Union Iron Works, $7,563. The contract was awarded to the Porter Mfg. Co., of SYRACUSE, N. Y.

Power House Superstructure & Chimney.—W. W. Robertson, $6,602; J. A. & J. G. McCune, $1,300 for chimney only. Contract awarded to W. W. Robertson, Sidney, O.

Pumps & Boilers.—Smith, Vaile & Co., one 1,500,000 gal. hor. duplex, $6,654; Two 60-in. 16 ft. tub. boilers, $2,349; Gordon Steam Pump Co., one 1,000,000 gal. hor. duplex, $3,200; one 1,500,000 gal. hor. duplex, $3,800; one 1,000,000 gal. vertical pump $6,200; one 1,500,000 gal. $6,700; two 60-in. 16 ft. tub. boilers $2,150; Barr Pumping Engine Co., one 1,000,000 gal. hor. duplex, $3,375; one 1,500,000 gal. $4,168; two 60-in. 16 ft. tub. boilers $2,614; The Holly Mfg. Co., one 1,000,000 gal. hor. duplex, $3,725; one 1,500,000 gal. $4,725; Two 60-in. 16 ft. tub. boilers $2,350. Contract awarded to the Gordon Steam Pump Co., of Hamilton, O.

Mechanical Filters.—National Water Purifying Co., $5,500; American Filter Co., $4,400; Jewell Pure Water Co.,$5,750; Oliphant Filter Co.,$4,500; Philadelphia Water Purifying Co., $5,000. Contract awarded to the American Filter Co.

Power House Substructure.—Griffin & Hussey, $14,291.10; Robertson & Fisher, $9,931.35. Contract awarded to Robertson & Fisher.

Pipe Laying.—Keating & Houston, $1,598.25; E.Clarke, $2,848.85; Hussey & Griffin, $5,916.25; J. W. Skillen, $2,400; Snyder & Williams, $1,757.50. Contract awarded to Keating & Houston.

Water-Works.—The following proposals have been received by J. D. COOK, C. E., of Toledo, O.. Engineer of the Milan, O., Water-Works.

VALVES, BOXES AND HYDRANTS.

Name and Address of Bidders.	Valves.					Boxes.		Hydrants.	
	4-in.	6-in.	8-in.	10-in.	Total Agg.	Price	Amt.	Pric	Amt.
R. D. Wood & Co. Philadelphia, Pa.	.....	$14.50	$20.	$28.	$135.50	$2.75	$19.25	$29.75	$357.
Holyoke Hydrant & Iron Works, Holyoke, Mass	.....	16.40	23.60	30.30	150.30	.....	.....	21.75	261.50
A. & W. S. Carr, Paterson, N. J.	.....	10.	16.	21.	99.	.....	.....	28.	336.
Bourbon Brass & Copper Works, Cincinnati, O.	.....	12.95	20.	27.50	126.35	.....	1	27.75	333.
						.....	1	29.	348.
Chapman Valve Mfg. Co., Indian Orchard, Mass.	.....	13.76	20.43	31.10	133.67	.....	1	25.76	309.12
						.....	1	29.43	353.16
Galvin Brass & Iron Works, Detroit, Mich.	.....	12.25	20.	27.50	124.25	.....	1	28.	336.
						.....	1	31.	372.
The Eddy Valve Co., Waterford, N. Y.	.....	18.	20.25	27.	141.75	.....	.....	26.	312.
Frontier Iron & Brass Works, Detroit, Mich.	$12.60	12.60	16.80	24.	110.40	.....	.....	.....	.....
Bingham & Taylor, Buffalo, N.Y. (Boxes only)	.....	3.60	3.60	3.95	.....	.....	25.20	.....	.....
Is. Cassin, Philadelphia, Pa.	8.	12.	19.	26.	119.	.....	.....	33.	396.
Holly Mfg., Lockport, N. Y.	.....	15.	23.	31.	145.	.....	.....	29.	348.
Ludlow Valve Mfg. Co. (by Lake Shore foundry)	.....	16.28	23.65	32.56	152.37	.....	.....	29.45	353.40
Approximate quantities.		3	3	1		7		12	

Pipe and Special Castings.—R. D. Wood & Co., $3,094.94. Lake Shore Foundry, $3,018.81; Ohio Pipe Co., $3,033.50; Detroit Pipe & Foundry Co., $3,279.95. Addyston Pipe & Steel Works, $3,065.83. House & Taylor, $3,086.15.

Pipe Laying.—House & Taylor, $1,158.20.

Iron Tower and Tank.—House & Taylor, for all work, including foundation, $3,109.10.

Pumping Machinery and Boilers.—Henry R. Worthington, one 1,000,000 galls. compound non-condensing, $2,250; one 1,000,000 galls. high pressure, $1,750; one 750,000 galls. compound non-condensing, $1,950; one 750,000 galls. high pressure, $1,650; Barr Pumping Engine Co., one 750,000 galls. compound non-condensing, $1,789; boiler, $1,018; one 1,000,000 galls. compound non-condensing and boiler, $3,157. National Iron Works, one 1,000,000 galls. vertical triple expansion, with boiler, $6,000; Knowles Steam Pump Works, $3,180: Hall Steam Pump Co., one 750,000 galls. H. P., with boiler, $2,354; one 750,000 galls. com. non-condensing, $1,568; one 1,000,000 galls. H. P., with boiler. $2,479; one 1,000,000 galls. compound non-condensing, $2,382; Volker & Felthousen, one 750,000 galls. H. P., $1,120; boiler, $965; one 750,000 galls' com. non-condensing, $1,520; one 750,000 galls. compound condensing, $1,845; one 1,000,000 galls. H. P., $1,205; one 1,000,000 galls. compound non-condensing, $1,690; one 1,000,000 galls. compound condensing, $2,025; Gordon Steam Pump Co., one 750,000 galls. compound non-condensing, $1,800; boiler, $960; one 750,000 galls. compound condensing, $2,150; two 750,000 galls. compound condensing, $3,650; one 1,000.000 galls. compound non-condensing $3,000; one 1,000,000 compound condensing, $3,600; Hughes Steam Pump Co., one 750,000 galls. compound non-condensing, with boiler, $3,275; one 1,000,000 galls. compound non-condensing, with boiler, $3,580; The Holly Mfg. Co., one 750,000 galls. compound non-condensing, $3,160; boiler, $1,125; one 1,000,000 galls. compound condensing, $4,600; one 750,000 galls. H. P., $1,520; one 1,000.000 galls. H. P., $2.125.

Government Work.—Proposals for the following named work have been received by Lieut. Col. HENRY M. ROBERT, Corps of Engineers, U. S. A., Philadelphia, Pa., for dredging in the Schuylkill River as follows: American Dredging Co., Philadelphia, Pa., 19 cts. per cu. yd. National Dredging Co., Wilmington, Del., 23⅛ cts.; Atlas Dredging Co., Wilmington, Del., 22⅛ cts.; F. C. Somers, Philadelphia, Pa., 20 cts. Furnishing and placing stone in the gap at the Delaware Breakwater: Mount Waldo Granite Works, Frankfort, Me., $3.73 per ton; A. M. Bangs, Fayetteville, N. Y., $1.09; The Brandywine Granite Co., Wilmington, Del., $2.53; J. Beattie, Leettes Island, Conn., $2.95; J. A. Bouker, New York, $2.33. For furnishing and delivering stone on United States barges in canals, stone for use at the Des Moines Rapids canal and dry dock, by Major A. MACKENZIE, Corps of Engineers, U. S. A., at Rock Island, Ill.> A. J. Whiting, Rock Island, 300 cu. yds. face stone, $10.50 per cu. yd.; 100 cu. yds. backing stone $6.00 per cu. yd.; 3,000 cu. yds. rip-rap face stone $2.30: Patterson Bros. Kookuk, Ia. $10, $6.00, $2.25.

Bridge.—The King Iron Bridge Co., of Cleveland, O., has been awarded the contract to build an iron bridge across the middle branch of the Croton river at South East Reservoir, Putnam Co., N. Y., for $3,885.

Pumping Works.—***Chicago, Ill.*** Bids were opened by the Commissioner of Public Works on Sept 26, for the erection of the new Central Pumping Works. Nine bids were received, the lowest being that of McDermott & O'Brien, who were to do the entire work for $23,478. The highest bidders were Tobin & Raycraft, at $31,927.

Sewers.—***St. Paul, Minn.*** The contract for constructing sewers on L'Orient and adjoining streets, and Western Avenue, has been awarded to E. J. Kirkland for $261,720. For constructing a sewer on Portland and Goodrich Avenues, and paving alley in block 4, to J. W. Doherty for $2,582.

WATER.

Flushing Sewers.—At Greenbush, N. Y., a contract for flushing the sewers has been made between the sewer commissioners and the water company. The contract provides for all the water that may be needed for flushing the sewers through the flush tanks, each tank to dump once in 24 hours, for $700. A separate contract has been made with the water company for tapping the mains, connecting them with the flush tanks, the water company to tap the mains for $1.50 each, and the commissioners to furnish the pipe.

The Coquitlam Water-Works Co. has been incorporated in British Columbia to build water-works and supply water to Port Moody, Vancouver and New Westminster, and other towns. The water will be taken from theCoquitlam river or lake, and the works are to be in operation within 4 years. The act of incorporation provides that no Chinese are to be employed on the work. The rates are not to exceed 30 cts. per 1,000 galls. for water, or $1 per month from any house with not more than 4 occupants, and 30 cts. per month for each additional occupant. The capital stock is $600,000, with power to increase to $1,000,000. President, E. A. WILMOT, C. E., of Victoria; Secretary, ARTHUR E. HILL; C. E., of Victoria; Directors, JOSEPH HUNTER, C. E., of Victoria; ALBERT J. HILL, C. E., of Port Moody; ALFRED G. FERGUSON, contractor, of Vancouver; CHAS. G. MAJOR, of New Westminster, and G. E. CORBOULD, of New Westminster.

Worthington Engines.—The city of Brooklyn awarded contract for two vertical compound condensing high duty pumping engines to Henry R.Worthington,the price being for a pumping plant complete, with boilers, $195,000. This award was made on the recommendation of Chief Engineer VAN BUREN of Department of City Works, the other bidders being the Holly Mfg. Co. and the Pioneer Iron Works of Brooklyn.

Water-Works.—***Vermont.***—Shelburne Point, near Burlington. A. R. Dow, C. E., of Burlington, is drawing plans and maps for the new water-works to be constructed by Dr. WEBB.

Massachusetts.—Boston. Water mains are to be laid to Moon and Long islands as soon as the controversy between the Water Board and the town of Quincy is settled.——Great Barrington. Pipe has been laid to Long lake, a distance of 6 miles, to conduct a water supply to Housatonic, and a dam will be built where the pipe is to enter the lake. The total cost of the work will be about $55,000.——Melrose. A new suction pipe and screen have been put into Spot Lake for the purpose of obtaining water at a greater depth.

Rhode Island.—Wakefield.—Work on the water-works has been resumed.——Newport. The Water-Works Co. is putting in a water main in Everett St. from Broadway to a point on Kay St. where a connection will be made.

Connecticut.—Hartford. Several driven wells have been sunk by manufacturers to secure a water supply, in order to escape the oppressive water rates.

New York.—Albany. The Russell road and Sand Creek road reservoirs, which will be at an elevation of 30 or 40 ft. higher than the present reservoir, will be completed by Nov. 1. Cranford & Valentine, of Brooklyn, have the contract. Water will be conveyed to them through a conduit, from Patroon's and Sand's creeks.——Albion. A preliminary test of the water-works has been made. ——Flushing, L. I. A petition for water mains on Central Ave., from Broadway to State St. has been referred to the Water Committee.——Sandy Hill. The distributing tower for the water-works has reached a height of 70 ft.——Plattsburg. A second line of pipe is being laid between the storage and distributing reservoirs.——Schenevus. The Schenevus Village Water-Works Co. has been organized. The officers are: President, C. H. GRAHAM, Schenevus; Treasurer, GEORGE BROOKS, of Cooperstown. Capital, $7,500. BYRON CASS, T. J. LEWIS and C. H. GRAHAM, were appointed a construction committee.——St. Johnland. W. H. RAY, President, has recommended to the Board of Supervisors, that EDWARD FREEL be granted a contract to connect several springs with the reservoir in order to increase the water supply, which at present is entirely insufficient. Also that a new 50 ft. high, 48-in diameter and ⅜-in. steel smoke-stack be placed on the boiler house.

New Jersey.—It is reported that the New Brunswick Water Board has discovered that immense quantities of water are being used at the State experimental farm by illegally tapping the mains.——Bayonne. A unanimous resolution has been passed by the common council, authorizing W. SANFORD, J. A. CADMUS and T. J. CRONIN, (Water Committee) together with City Attorney FULLER, to negotiate with outside parties for the establishment of a new supply of water, to be delivered Nov. 1, 1890.

Pennsylvania.—Bridgeport. It is reported that water-works are projected. Address JOSEPH LEE.——Lancaster. The new 5,000,000 Worthington pump, when put in operation, gave excellent satisfaction.

Maryland.—Baltimore. Mayor Latrobe has refused to sign the BANKARD water ordinance which would make a reduction of $80,000 in the total receipts of the water rates and increase the taxes $125,000. The expense per year for distribution, laying pipes and building the water-works is said to be $650,000.

Virginia.—Goodson. Water-works to cost $28,000 are to be constructed by the Glamorgan Iron Co., of Lynchburg, Va.——Portsmouth. The question of extending the mains to Berkely is being favorably considered by the water-works company.——Roanoke. The new reservoir be supplied from the spring has been completed. C O'LEARY is Superintendent.

North Carolina.—Spartanburgh. It is reported that the water-works company is now working on the water-works system.

Alabama.—Decatur. All work on the new water-works has been suspended until the recent attack of yellow fever subsides. Geo. A. Ellis, the contractor, has left the city.

Louisiana.—Baton Rouge. It is reported that the water-works have been satisfactorily tested, and will soon be put in full operation.

Texas.—Galveston. The Winne Street artesian well, near Bath Ave., has reached a depth of 228 ft. Work will soon be started on well No. 3.

Ohio.—Delaware. The City Council by a vote of nine to one has passed the water-works ordinance granting franchise to, and making contract with the firm of Mofett, Hodgkins & Clarke, of Watertown, N. Y., for the construction of a system of water-works.

Michigan.—Grand Rapids. The Hydraulic Co's. new standpipe, which is 100 ft. high and about 250 ft. above the surface of the river, built of ⅝-in. steel plates, each 8 ft. long and 5 ft. wide, with a capacity of 235,000 galls. is nearly completed. Water will be furnished by direct pressure. The company now has about 25 miles of pipes laid in the streets of this city, and the water, which is umped from Silver Creek, is of good quality.

Illinois.—Hyde Park. The Holly Mfg.Co., of Lockport, N. Y., will probably secure the contract for Hyde Park's additional pumping-works, although the bid was $4,300 higher than that of another company. The matter will be settled at the next meeting of the board.——Lake View. Mayor BOLDENWECK has been granted power by the Council to secure a plan for a water tunnel extending 6,000 ft. into the lake.——Sullivan. Water-works are to be established. A wind pump and a tank 50 ft. high, which will hold 51,000 galls., will be used to supply the water.

Minnesota.—Minneapolis. The first of the two Worthington pumps recently ordered, and which was to have been in operation Aug. 1, has not yet arrived.——Winona. Complaints still continue to be made of the great inefficiency manifested in the management of the water-works.

Nebraska.—Minden. It is reported that water-works will be constructed.

Colorado.—Denver. The water mains should be extended throughout all parts of the sewer districts.

Montana.—Helena. A test of the Woolston water-works recently showed a pressure from five streams of 90 lbs. to the square inch.

California.—Portersville, Tulare county, is to have a system of water-works. A reservoir containing 3,000,000 galls. has been built.——Redland. The contract for cementing the Domestic Water Co.'s big reservoir has been let and the work is to be pushed to a speedy completion.——

At a recent meeting of the Directors of the Bear Valley Water Co., an assessment of $6 per share was levied for the purpose of paying off debts contracted during the summer.

Oregon.—Portland. A 3-in. water pipe has been put in, connecting the city cistern with the main on Fifth and Morrison Streets.

Washington Territory.—Seattle. The Cedar Valley Water Co., Seattle, W. T., has been incorporated. The object is to supply Seattle with water from the Cedar river, a distance of 12 miles. The capital stock is $200,000, divided into $20,000 shares. The first trustees are F. M. FRINK, H. A. RAY and L. A. TREEN, of Seattle, and W. H. MURRAY and A. ASHDOWN, of San Francisco.

Pumping Plant.—The Park Commissioners, of San Francisco, Cal., have decided to improve the pumping plant at a cost of $4,000.

Oceanside, Cal.—A company has been organized, with a capital stock of $5,000,000 to build flumes to convey the water of the San Luis Rey river from Smith mountain to Oceanside, a distance of 40 miles.

San Antonio, Tex.—The flow of the artesian well at the West End has been measured carefully by Mr. DAVID DONALDSON, the engineer of the company. He reports it to be 82.23 galls. per minute, or 118,555 galls. per day.

Denver, Col.—The Denver Electric Light Co. will place its wires underground, and has received 10 car loads of cable for that purpose from the Standard Underground Cable Co., of Pittsburg, Pa. The Westinghouse alternating system is used for illumination.

The Saco Water Power Co. has been incorporated in Maine. President, GEORGE DEXTER, of Boston, Mass.; Secretary, WINFRED S. DENNETT, of Saco, Me.; Directors, THOMAS WIGGLESWORTH, JAMES LONGLEY, GEORGE F. FABYAN, C. P. BOWDITCH, HENRY D. GREW, and W. P. WALLEY, all of Boston, Mass.

Stand-Pipe.—The Sharon Boiler Works of Sharon, Pa., are now getting out the material for a steel stand-pipe, 20 ft. diameter and 100 ft. high, to be erected at Washington, Ind. The works also have an order for a boiler for Middlesex, Pa.

Pumps.—The Cook Well Co., St. Louis, Mo., has sold pumps for the water-works at Tecumseh, Edgar, Orleans, Pawnee City and Central City, Neb.

Springfield, Mo.—A bill has been introduced to issue $200,000 of city bonds for sewerage according to the plans of Col. GEORGE E. WARING, of Newport, R. I. A proposition regarding the proposed extension of the sewerage system has also been received from W. KENSLEY, of Kansas City, Mo. Col. WARING has made a proposition to take the levels or to make an examination if the levels are taken by the City Engineer.

Fuel Gas Mains.—E. W. LEE, 332 Walnut St., Philadelphia, Pa., purchasing agent for the Mutual Gas Light Co., of Savannah, Ga., may require some new mains for fuel gas extensions. The company is now arranging to manufacture and supply throughout the city, a special fuel gas in itself non-illuminative, but which will give a high class light with the Welsbach patent burner. This fuel gas will be in addition to the ordinary illuminating gas, which the company supplies exclusively to the city at present.

Asphaltum in Texas.—Experimental wells are still being dug at the oil fields 10 miles east of Palestine. Since the company has been organized 10 wells have been sunk, each well developing a vein of asphaltum substance, ranging from 5 to 30 feet in thickness. The president of the Gibson Asphaltum Co., of St. Louis, Mo., pronounces the substance a genuine article of asphaltum, and assures the parties interested, at Palestine, Tex., that abundant capital can be easily obtained to develop and work the mines whenever it is definitely known that the quantity is sufficient to warrant the investment. So far the tests show that the veins cover several miles in extent.

Gas Works.—***Concord, N. H.***—For the year ending June 30, the Concord Gas Light Co. has sold 20,921,000 cu. ft. against 18,290,000 for the previous year, an increase of 2,631,000, or nearly 15 per cent. The quantity of coal carbonized has been 2,242 tons against 2,011 tons. The cost of the new gas holder, now being erected, with connecting pipes, stone masonry, grading, etc., will be about $35,000. Its capacity is 120,000 cu. ft. JOHN KIMBALL is President.

Hamilton, O.—An ordinance has been passed to submit the question of issuing $150,000 of bonds for the building of gas works to the electors at the November election.

Knoxville, Tenn.—The Knoxville Gas Co. will put in new plant at a cost of about $30,000.

Durham, N. C.—The Durham Gas Co. has been organized, with a capital stock of $60,000. President, J. S. CARR.

Cartersville, Ga.—The contract for gas works has been let to the Oriental Light Co., of Boston, Mass.

Decatur, Ala.—A St. Louis company will establish a gas plant at a cost of $50,000.

Special Reports of Water-Works Construction.

THE ENGINEERING NEWS MANUAL OF AMERICAN WATER-WORKS is now being compiled, and will be *indispensable* to every manufacturer, engineer and contractor in any way interested in Water-Works construction and maintenance, and will be of great value to Water-Works superintendents and projectors of new works.

Superintendents of water-works and water companies will wish to see correct and complete data concerning their Works in our MANUAL, and to ensure this they should send in reports *at once* upon the blanks which we have already sent to every Water-Works office in the United States and Canada. Many have delayed their report, and if the blanks we intended for them have been lost in the mail, or mislaid, we will send more upon request.

We *must* have a report from every public water supply system in North America, so those who reply to our inquiries at once will save a second inquiry. We also wish to know of *every* new Water-Works plant in process of construction, and of *every* new project in this line. We will send to any one desiring them, blanks upon which reports can be made.

Further details of the MANUAL will be advertised later. We abstract from our special reports for the MANUAL the following items of current interest:

UTICA, N. Y., Oct. 6, 1888.

EDITOR ENGINEERING NEWS:—The Town of Groton, Tompkins Co., N. Y., (population, 1,000) is to have a water supply from reservoirs, located on the hill. The probable cost of the works, which are to be built by the village authorities, they letting contract to the Moravia Water-Works Co., will be about $30,000. The contract for all material has been awarded to CHAS. MILLAR & SON, of Utica, N. Y., for $15,000. It will include 30,000 ft. of 8, 6, 4 and 3-in. cast-iron pipe, 45 hydrants, valves, extension boxes and the necessary pig-lead. The works were begun Aug. 1, and will probably be completed by Nov. 1.

CHAS. MILLAR & SON, *Contractors.*

SAN BERNARDINO, Cal., Oct. 1, 1888.

EDITOR ENGINEERING NEWS:

A system of water-works is to be established by the city, to cost about $100,000, which amount will be secured by bonds, not yet voted. A. H. KOEBIG, City and Civil Engineer, has made the surveys, though the matter is not fully decided upon, to take the supply from canons about 9 miles north of the city and conducted to a stand-pipe by gravity. The present supply is obtained from artesian wells. Population 10,000.

A. H. KOEBIG, *C. E. & City Engineer.*

ANTONITO, Col., Sept. 30, 1888.

EDITOR ENGINEERING NEWS:

Money is now being subscribed by the property holders, with which to experiment in sinking an artesian well to secure a better water supply. Water is now furnished by the Antonito Ditch Co., from the Conejos river, and conveyed through a ditch to the town. From the general topography of the country it is believed a plentiful supply of water can be obtained from a depth of 100 to 150 ft. or less. Fifteen miles eastward a good pressure was obtained from a well 90 ft. deep, but no well has been put down here yet to test the matter. The contract will probably be let within 30 days, for work to be begun at once and completed about April 1, 1889. Population 600.

S. W. KRUPP.

We give below a report from Moffett, Hodgkins & Clarke, of Watertown, N. Y., regarding the water-works at Portage, Wis., in which they correct some misstatements made in our account of these works given in our issue of Sept. 22, 1888.

The works were commenced in April, 1887, and completed Jan. 1, 1888. They were designed by E. GEO. FERRISS, who was also Constructing Engineer. The contract for the works was awarded to Moffett, Hodgkins & Clarke, of Watertown, N. Y., who sublet contracts as follows: For masonry, foundations and buildings, Peter Mills: for pumping machinery, Henry Worthington, of New York; for pipe and specials, trenching and pipe laying, Warren Foundry & Machine Co., of Phillipsburg, N. J.; for valves and hydrants, Ludlow Valve Mfg. Co., of Troy, N. Y.; for stand-pipe, Riter & Conley, of Pittsburg, Pa. The supply is drawn from the Wisconsin river and is pumped to a stand-pipe 25 ft. diameter and 80 ft. high, by a Worthington pumping engine with a daily capacity of 2,000,000 galls.; direct pressure can also be applied. There are 82 miles of pipe, 75 hydrants, 150 taps and 9 meters; the mains are of cast-iron, and the services of galvanized iron. Ordinary pressure, 65 lbs.; fire-pressure 150 lbs. Cost of works, $125,000; debt, $100,000; rate of interest 6 per cent. Annual revenue, from city, $3,300. The franchise is for 25 years, and the hydrant rental is $40 per hydrant per annum. The works are owned by a company which is controlled by Moffett, Hodgkins & Clarke; President, E. GEO. FERRISS; Vice President, J. F. MOFFETT; Treasurer, J. V. CLARKE. Bonds have been issued for $100,000. J. W. READE is Superintendent. Present population, 6,000.

RECORD OF NEW WATER WORKS CONSTRUCTION.

(Specially communicated).

CONTINUED FROM PAGE 278.

Chillicothe, Mo.—The works were commenced May 15, 1887, and completed Sept. 15, 1887. They were designed by S. H. LOCKETT, of New York, and J. M. WALKER, of Lawrence, Kan., was Constructing Engineer. The contractors were COMEGYS & LEWIS, of New York; the pipe, specials and stand-pipe were furnished by the Shickle, Harrison & Howard Iron Co., of St. Louis, Mo.; and the valves and hydrants by the Ludlow Valve Co., of Troy, N. Y. There are two Hyatt filters, 6½ ft. x 13 ft. The source of supply is Grand river, and the water is pumped to a standpipe 12½ ft. diameter and 165 ft. high, by two Worthington duplex compound pumping engines with a daily capacity of 1,000,000 galls. each. There are two 80 H. P. steel tubular boilers, built by the Pond Engineering Co., of St. Louis. The reservoir has a capacity of 125,000,000 galls. There are 8¼ miles of pipe, 91 hydrants, 59 taps and 1 meter: the mains are of cast-iron and the services of galvanized iron and lead. Average daily consumption, 90,000 galls. Ordinary pressure, 50 lbs.; fire pressure, 150 lbs. Cost of works, $200,000. Annual expense, about $4,000. Annual revenue from consumers, $6,000; from city, $3,185. The water is piped from the river, a distance of 2 miles, and has 100 ft. head. The franchise is for 20 years, and the hydrant rental is $35 per hydrant per annum. The works are owned by the Chillicothe Water, Gas & Electric Light Co.; President, A. G. BLACK; Secretary and Treasurer, J. W. MAGUIRE. Capital stock, $350,000. N. C. IRWIN is Superintendent. The present population is between 6,000 and 7,000. The number of taps was small at the date of the special report (Feb. 10, 1888) as the works were finished late in the fall and cold weather stopped all work in that direction.

Colfax, Ia.—The works were commenced in June, 1887, and completed August 1, 1887. The engineers in charge of construction were M. D. MORRISON, R. N. STEWART and G. A. GOODRICH. [The special report gives the Designing Engineer as "City Council"]. The works are completed to the extent of the mains. There were no contracts, all the work being done under the supervision of the parties above named. The pumping machinery was furnished by the Cameron Pump Co.; the pipe and specials by Dennis, Long & Co., of Louisville, Ky.; Ludlow valves and hydrants were used. The ditching was done by P. H. Cross, of Colfax; small fittings, etc., were supplied by F. E. Welom and Kesfoot Bros., of Des Moines. The water is taken from three well points, 3 ins. diameter, 5 ft. long, 19 ft. in the gravel; the supply is by gravity from a reservoir 20 ft. deep by 24 ft. diameter with a capacity of about 2,200 galls. There is a No. 7 Cameron pump, 2½-in. discharge, with a daily capacity of 86,400 galls. There are 6,400 ft. of pipe (2,400 ft. of 6-in., 1,600 ft; of 4-in., 1,300 ft. of 2-in., 1,100 ft. of 1-in.), 9 hydrants and 47 taps. Average daily consumption, 12,000 galls. Ordinary and fire pressure, 60 lbs. Cost of works, $6,800; debt, $6,000; rate of interest, 6 per cent. Annual operating expense, $200. Annual revenue from consumers, $400. The works are owned by the city and controlled by the city officials; city bonds, $6,000; water is sold to private parties and is free to the city. The Superintendent is G. A. GOODRICH, of Colfax. The present population is 1,100.

The town voted to bond itself to the extent of 5 per cent. of the assessed valuation in March, 1887, and the bonds were sold at $1.01 to run 15 years at 6 per cent., payable annually. The works cost in total about $6,800, and this is the total amount of indebtedness of the town. The charge for families is about $7 per year for the 47 taps: and 5 hotels using the water, pay about $125, making the total income about $400, and it is hoped to more than double the amount this summer; it is expected that the works will pay for themselves by the time the bonds are due, although there is a 5 mill tax per year to provide for interest and sinking fund. The reservoir is situated 140 ft. above the pump, which has a 5 x 15-in. water cylinder, 10 x 15-in. steam cylinder, and raises the water from the wells and forces it into the reservoir easily, with 25 lbs. steam pressure. There is a 25 H. P. boiler, and a power house 60 ft. by 20 ft. The small mains are for supplying families only, as the 6-in. and 4-in mains are in such position that with 500 ft. of hose almost any building in the town can be reached, with 60 lbs. pressure; the works being very complete and efficient for the money invested. From the pump to the reservoir is a distance of 2,840 ft., entirely on the main street of the town.

(TO BE CONTINUED).